Food and Agriculture
Organization of the
United Nations

Convention on
Biological Diversity

SOCIETY FOR
ECOLOGICAL
RESTORATION

DELIVERING RESTORATION OUTCOMES FOR BIODIVERSITY AND HUMAN WELL-BEING

Resource guide to Target 2 of the Kunming-Montreal
Global Biodiversity Framework

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Resource guide to Target 2 of the Kunming-Montreal Global Biodiversity Framework

Published by

The Food and Agriculture Organization of the United Nations
and
The Secretariat of the Convention on Biological Diversity
and
The Society for Ecological Restoration (SER)

Rome, Montreal, Washington, DC 2024

Required citation:

FAO, SCBD & SER. 2024. *Delivering restoration outcomes for biodiversity and human well-being – Resource guide to Target 2 of the Kunming-Montreal Global Biodiversity Framework*. Rome, Montreal, Canada and Washington, DC. https://doi.org/10.4060/cd2925en

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ISBN 978-92-5-139246-1 [FAO]

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Contents

Abbreviations VI

Acknowledgements VII

Authors and contributors VIII

Executive summary IX

1. Introduction 1

2. What is restoration? 5

- 2.1 Major types of restoration 6
- 2.2 Restoration approaches 12

3. The key elements of Target 2 13

- 3.1 Document the baseline 15
- 3.2 Set national targets 17
- 3.3 Define restoration outcomes 19
- 3.4 Apply principles of effective restoration 22
- 3.5 Across all major ecosystem types 26

4. Global initiatives aligned with Target 2 33

- 4.1 The United Nations Decade on Ecosystem Restoration 2021-2030 34
- 4.2 The United Nations Decade of Ocean Science for Sustainable Development 2021-2030 36

5. Integrating Target 2 into national biodiversity targets and updated NBSAPs 37

- 5.1 Incorporating key components of Target 2 into NBSAPS 40
- 5.2 Linkages to KM-GBF goals and other targets 43
- 5.3 Who to involve 47

6. How to implement restoration commitments for Target 2 51

- 6.1 Assessment of opportunities for ecosystem restoration 52
- 6.2 Improving the institutional enabling environment for ecosystem restoration 54
- 6.3 Planning, implementation, and ongoing management of ecosystem restoration activities 60
- 6.4 Monitoring, evaluation, feedback and sharing results 65

7. Required monitoring and reporting of Target 2 at the national level across ecosystems 79

- 7.1 Target 2 headline indicator methodology and meta-data 81
- 7.2 Target 2 component indicator on land degradation 86
- 7.3 The Framework for Ecosystem Restoration Monitoring (FERM) 88
- 7.4 National reporting 91
- 7.5 Data sharing and interoperability 91

Glossary 93

References 97

Annex A. What is degradation? 115

Annex B. A history of the concept of effective restoration 116

Annex C. Considerations for the implementation of the Kunming-Montreal Global Biodiversity Framework 117

Annex D. Opportunities for synergies between Rio conventions 119

Annex E. Additional resources, guidelines, and tools 120

- A. Assessment of opportunities for ecosystem restoration 122
- B. Improving the institutional enabling environment for ecosystem restoration 128
- C. Planning, implementation, and ongoing management of ecosystem restoration Activities 134
- D. Monitoring and reporting Target 2 at the national level across ecosystems 143

Boxes

Box 2.1: Restoration terminology helper – a review of key concepts and their relationship with the objectives of the KM-GBF 8

Box 3.1: Guidance and standards to support effective restoration 22

Box 3.2: Attributes of effective restoration for rehabilitation and ecological restoration 24

Box 5.1: NBSAP tools and guidance 38

Box 5.2: Indigenous Peoples as game changers in biodiversity conservation 48

Box 6.1: The European Union Nature Restoration Law 60

Box 7.1: Disaggregation of area under restoration 85

Figures

Figure 2.1: The restorative continuum includes a range of activities and interventions that can reverse ecosystem degradation and landscape fragmentation leading to enhanced biodiversity and ecosystem functions and services, ecological integrity, and connectivity, thus contributing to Target 2 7

Figure 2.2: Relationships and transitions between major land use types based on implementation of different ecosystem restoration types, ongoing degradation, and transformation 11

Figure 2.3: Rehabilitation and ecological restoration in the context of the Target 2 required outcomes 11

Figure 3.1: The key elements of Target 2 14

Figure 3.B1: The Jaguar Corridor 21

Figure 3.2: Principles that underpin the United Nations Decade on Ecosystem Restoration 26

Figure 3.3: A comparison of major ecosystem types in terms of key restoration factors as they relate to Target 2 29

Figure 5.1: Major milestones for the KM-GBF from 2022 to 2030 and 2050 39

Figure 5.2: Relationship of the KM-GBF Target 2 to other national commitments 41

Figure 5.3: Relationships between Target 2 and other KM-GBF targets 45

Figure 6.B1: Priority restoration and conservation sites for biodiversity in Mexico 64

Figure 6.B2: Restoration sites that enhance connectivity in Mexico 64

Figure 6.1: Visual representation of three major types of ecosystem restoration project monitoring 67

Figure 6.2: An example of SER's Five-star System used to populate the Ecological Recovery Wheel at baseline (left) and 10 years under restoration 73

Figure 7.1: Workflow for monitoring and reporting on headline indicator 2.1, Area Under Restoration 81

Figure 7.2: The FERM interoperability and default data 89

Tables

Table 3.1: Examples of definitions of degradation of relevance to Target 2 15

Table 6.1: Headline indicators identified by the Restoration Project Information Sharing Framework (ISF) 71

Table 7.1: Example of a default dataset with compiled restoration data from multiple sources 83

Table 7.2: FERM registry fields and descriptions 89

Case studies

Case Study 3.1 Restoring the Murray-Darling Basin 18

Case Study 3.2 Connectivity of jaguars *(Panthera onca)* in Latin America: a case study of the Maya Forest Corridor, Belize 20

Case Study 3.3 Exploring the classification of ecosystem types in Vietnam as a basis for assessing conservation status and implementing restoration activities 27

Case Study 5.1 Governance challenges: Towards efective ecosystem restoration in Peru, an example of disaggregation in pursuit of a whole-of-government approach 50

Case Study 6.1 Maximizing agroforestry's productive and restorative potential through policy support in India 55

Case Study 6.2 Kenya landscape restoration monitoring technical working group and restoration monitoring framework 59

Case Study 6.3 Mexico's information system for environmental restoration 64

Case Study 6.4 Review of near-shore marine restoration to improve wildlife abundance and diversity 70

Case Study 7.1 African Forest Landscape Restoration Initiative — an application of FERM interoperability 92

Abbreviations

AFR100 — African Forest Landscape Restoration Initiative.

CBD — Convention on Biological Diversity.

CIFOR-ICRAF — Center for International Forestry Research-International Centre for Research in Agroforestry.

DCCEEW — Department of Climate Change, Energy, the Environment and Water (Australia).

FAO — United Nations Food and Agricultural Organization.

FPIC — Free, Prior and Informed Consent.

FERM — Framework for Ecosystem Restoration Monitoring.

GEF — Global Environment Facility.

GET — IUCN Global Ecosystem Typology.

ISF — Restoration Project Information Sharing Framework.

IUCN — International Union for Conservation of Nature.

KM-GBF — Kunming-Montreal Global Biodiversity Framework.

LDN — Land Degradation Neutrality.

MEAs — Multilateral Environmental Agreements.

NDCs — Nationally Determined Contributions under the UNFCCC.

NGOs — non-governmental organizations.

NBSAP — National Biodiversity Strategy and Action Plan.

SBSTTA — Subsidiary Body on Scientific, Technical and Technological Advice.

SCBD — Secretariat of the Convention on Biological Diversity.

SDGs — UN 2030 Sustainable Development Goals.

SEEA — System of Environmental-Economic Accounting.

SER — Society for Ecological Restoration.

SOPs — standards of practice.

STAPER — Short Term Action Plan on Ecosystem Restoration.

UN Ocean Decade — United Nations Restoration Decade of Ocean Science for Sustainable Development.

UN Restoration Decade — United Nations Decade on Ecosystem Restoration.

UNCCD — United Nations Convention to Combat Desertification.

UNDP — United Nations Development Programme.

UNEP — United Nations Environment Programme.

UNESCO — United Nations Educational, Scientific and Cultural Organization.

UNFCCC — United Nations Framework Convention on Climate Change.

Acknowledgements

The authors would like to thank the team of the Food and Agriculture Organization of the United Nations, the Secretariat of the Convention on Biological Diversity and the Society for Ecological Restoration for contributing to this publications.

In addition, the authors would like to thank Sandi Schwartz for editing, Anna Rekina for layout design and Brooke Weiland for figure design.

The authors would also like to thank the following individuals and organizations for preparing and submitting the case studies:

- Case study 3.1: Department of Climate Change, Energy, the Environment and Water of Australia
- Case study 3.2: Allison L. Devlin, Dr. Bart Harmsen (Panthera), Aaron Laur, and Gabriel Oppler (Center for Large Landscape Conservation)
- Case study 3.3: Van Tu Do (Institute of Ecology and Biological Resources, Vietnam Academy of Science and Technology) and Tuyet Tang (CIFOR-ICRAF)
- Case study 5.1: Valentina Robiglio and Rocio Vasquez (CIFOR-ICRAF)
- Case study 6.1: Priya Pajel and Elaine Springgay (FAO)
- Case study 6.2: Khalil Walji (CIFOR-ICRAF)
- Case study 6.3: Patricia Koleff, Wolke Tobón and Tania Urquiza-Haas (National Commission for the Knowledge and Use of Biodiversity of Mexico, CONABIO)
- Case study 7.1: Gregory Obiang (FAO)

This publication was produced with the financial and technical support of the Korea Forest Service of the Republic of Korea and its Forest Ecosystem Restoration Initiative, the United Nations Decade on Ecosystem Restoration supported by the International Climate Initiative of Germany, and the AIM4Forests programme supported by the United Kingdom of Great Britain and Northern Ireland.

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Executive summary

With the adoption of the Kunming-Montreal Global Biodiversity Framework (KM-GBF) in 2022, the Convention on Biological Diversity (CBD) adopted its global Biodiversity Plan for Life on Earth. Central to that plan, and to creating a world where people live in harmony with nature, is ecosystem restoration, Target 2 of the KM-GBF.

Ecosystem restoration is an inherently participatory act that creates or helps recreate a healthy, mutually beneficial relationship between people and nature. Ecosystem restoration can be implemented at every scale, from hyper-local smallholder to landscape or seascape scale trans-national projects and programmes. Ecosystem restoration inspires individuals and institutions alike, and especially when planned and implemented in combination with sustainable use and conservation, it has the potential to deliver a balanced net gain for people and nature.

The promise of ecosystem restoration is profound, and our global challenge is to meet that promise. This resource guide provides background information, recommendations and guidance to support CBD Parties and partners to effectively apply the still limited, but expanding financial and human resources to achieve the greatest potential impact from restoration investments.

A broad suite of multilateral environmental agreements and initiatives already promote, include or incentivize ecosystem restoration, including the UN Decade on Ecosystem Restoration. As such, this guide builds on a very solid foundation of existing work and reminds Parties that their implementation of Target 2 will also likely build on an equally solid foundation of work they have already undertaken in the context of other agreements and initiatives. Target 2 elevates and coalesces this work into a new global objective for restoration, for life on Earth.

The guide explores and explains the intent and practicalities of Target 2. It starts by setting this target into the global context of other global initiatives and national commitments. It provides a detailed look into the key components and intended outcomes, and how Parties can address these in their National Biodiversity Strategies and Action Plans (NBSAPs). It explores and compiles a broad suite of globally relevant resources to support countries as they implement the target across terrestrial, inland waters, and coastal and marine ecosystems, as well as production landscapes. The guide builds on the CBD's Short-Term Action Plan on Ecosystem Restoration (STAPER).

The guide is intended to be a living document and is part of a series of capacity building and country support resources that CBD, FAO and several other global partners are developing to assist Parties, from e-learning courses to country or regional workshops to support target setting, restoration planning and implementation. These resources will be regularly updated and expanded during the remainder of the decade. We invite you to use this guide to support your efforts to achieve Target 2, and to engage with the CBD Secretariat about additional resources and tools still needed to further advance your country's work to create balanced net gain for people and nature through ecosystem restoration.

1. INTRODUCTION

The Kunming-Montreal Global Biodiversity Framework (KM-GBF) was adopted by the Parties to the Convention on Biological Diversity (CBD) in December 2022. Among the Framework's key elements are four goals for 2050 and 23 targets for 2030. Target 2 of the KM-GBF states: "Ensure that by 2030 at least 30 percent of areas of degraded terrestrial, inland water, and coastal and marine ecosystems are under effective restoration, in order to enhance biodiversity and ecosystem functions and services, ecological integrity and connectivity."

Target 2 is critically important to the KM-GBF because human-induced habitat degradation over decades has resulted in a decline in biodiversity; ecosystem functions and services; and resilience in terrestrial, inland water, and marine and coastal ecosystems. It is viewed as imperative to setting and achieving many goals and targets of the KM-GBF, including the recovery of biodiversity and the delivery of ecosystem functions and services. It is central to Goals A and B and is tightly linked to Target 1 on landscape and seascape approaches and spatial planning, Target 3 on protected and conserved areas,[1] Target 10 on sustainable production, Target 11 on nature's contributions to people and many others. The role of restoration in helping to achieve other Multilateral Environmental Agreements (MEAs) is also increasing. Due to overlapping commitments related to restoration, it is critical that countries coordinate restoration activities across agreements and align with national goals and policies. Effective restoration takes time to assess, plan, implement and monitor, and ecosystem recovery may take long periods of time. As such, it is critical that the restoration components of the KM-GBF are initiated in a timely manner and meet the 2030 deadline.

The Strategic Plan for Biodiversity 2011-2020, through its Aichi Biodiversity Targets, was the first agreement within the CBD process to explicitly call for restoration. Aichi Target 14 called for restoration to ensure the provision of essential ecosystem services. Aichi Target 15 called for the restoration of 15 percent of degraded ecosystems, thus contributing to climate change mitigation and adaptation and combating desertification. However, progress was limited. Despite the ambition of the Aichi Targets, degradation continued to outpace restoration globally, which exacerbated biodiversity loss and hindered the delivery of ecosystem services in many areas. Although the area committed to restoration was high, national strategies were mostly project focused, missing the opportunity to develop large-scale initiatives that integrated different strategies across the landscape (CBD, 2015). The Global Biodiversity Outlook 5 (CBD, 2020) recommended a transformative pathway forward: "Efforts to conserve and restore biodiversity need to be scaled up at all levels using approaches that will depend on local context. These need to combine major increases in the extent and effectiveness of well-connected protected areas and other effective area-based conservation measures, large-scale restoration of degraded habitats, and improvements in the condition of nature across farmed and urban landscapes as well as inland water bodies, coasts and oceans."

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[1] Within the context of the KM-GBF, Target 3 includes Protected and Conserved Areas, Other Effective Area-based Conservation Measures (OECMs) and Indigenous Territories.

The purpose of this resource guide is to assist countries and partners in translating restoration commitments into restoration plans and programmes, and implementing restoration at scales called for in Target 2, including the development of indicators and monitoring and reporting protocols. It is not a stepwise prescriptive planning document, but rather explores key topics and provides resources essential to understanding and successfully setting targets and implementing plans for restoration, including the role of different key practitioners, implementers, and rights and knowledge holders such as Indigenous Peoples.

Section 2 explores the topic of what constitutes ecosystem restoration, including definitions and descriptions of key terms; Section 3 describes key elements of Target 2; Section 4 discusses other global initiatives aligned with Target 2; Section 5 describes how to integrate Target 2 into national biodiversity targets and updated National Biodiversity Strategies and Action Plans (NBSAPs); Section 6 discusses how to implement restoration commitments for Target 2, based on the four major groups of activities identified in the Short-term Action Plan on Ecosystem Restoration (STAPER; CBD/COP/DEC/XIII/5); and Section 7 provides key information on required monitoring and reporting Target 2 at the national level.

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Central to achieving 30 percent of degraded ecosystems under restoration globally is the development or revision of national restoration targets and the incorporation of restoration into NBSAPs.

The selection of restoration targets requires the systematic assessment of biodiversity and ecosystem degradation within countries and the prioritization of restoration actions.

Wherever possible, pre KM-GBF baseline conditions should be documented, taking into consideration that concepts of degradation are different between natural and production ecosystems. For example, increased nutrient levels in agricultural soils are generally beneficial, while they may be a form of degradation in many natural ecosystems. Acknowledging that key terms in Target 2 can be interpreted in different ways, it is essential that they are interpreted in the spirit of the KM-GBF to achieve rapid, ambitious and large-scale restoration of ecosystems globally (Bell-James *et al.*, 2024). To assist in this process, this Resource Guide is especially focused on developing consistent definitions and descriptions of key terms and concepts that can facilitate the understanding, planning and implementation of effective ecosystem restoration by countries and their partners.

Different human rights-based approaches to ecosystem restoration are also relevant here, particularly in those that work with Indigenous Peoples, recognizing their unique rights and relationships with the environment. The Indigenous Peoples´ biocentric restoration approach, which combines traditional knowledge and cultural practices along with strengthening governance systems and recognizing their rights to their lands and territories, is essential for the effective management and conservation of biodiversity (Nelson *et al.*, 2024). These efforts directly contribute to the success of targets 1, 2, 3 and 22.

2. WHAT IS RESTORATION?

The term ‘restoration’ as used in the KM-GBF, including for Target 2, aligns with the term ecosystem restoration used by the CBD in the STAPER and as defined by the UN Decade on Ecosystem Restoration (UN Restoration Decade). The UN Restoration Decade has formally defined ecosystem restoration in the launching report “Becoming Generation Restoration” as “the process of halting and reversing degradation, resulting in improved ecosystem services and recovered biodiversity. Ecosystem restoration encompasses a wide continuum of practices, depending on local conditions and societal choice” (UNEP, 2021).

2.1 Major types of restoration

The process of ecosystem restoration includes a wide array of types, approaches and activities that halt and reverse degradation along the restorative continuum (Fig. 2.1). It can occur in natural, semi-natural and production ecosystems, and from densely populated or developed urban and agricultural landscapes to high integrity landscapes in protected and conserved areas, including Indigenous Peoples’ lands and territories.[2]

However, in order for an activity to be considered ecosystem restoration, it must result in a net gain for biodiversity, ecosystem health and integrity, and human well-being, including the sustainable production of goods and services (FAO *et al.*, 2021).

It is also important that the potential for restoration is not used as a pretext for the destruction of natural ecosystems or the depletion of biodiversity (Gann *et al.*, 2019). Recovery of ecosystem attributes (e.g. species composition, soil fertility) can be partial, nearly complete or complete (i.e. full recovery). See Box 2.1 for a review of several key concepts related to restoration including explanations of how they intersect and differ.

---

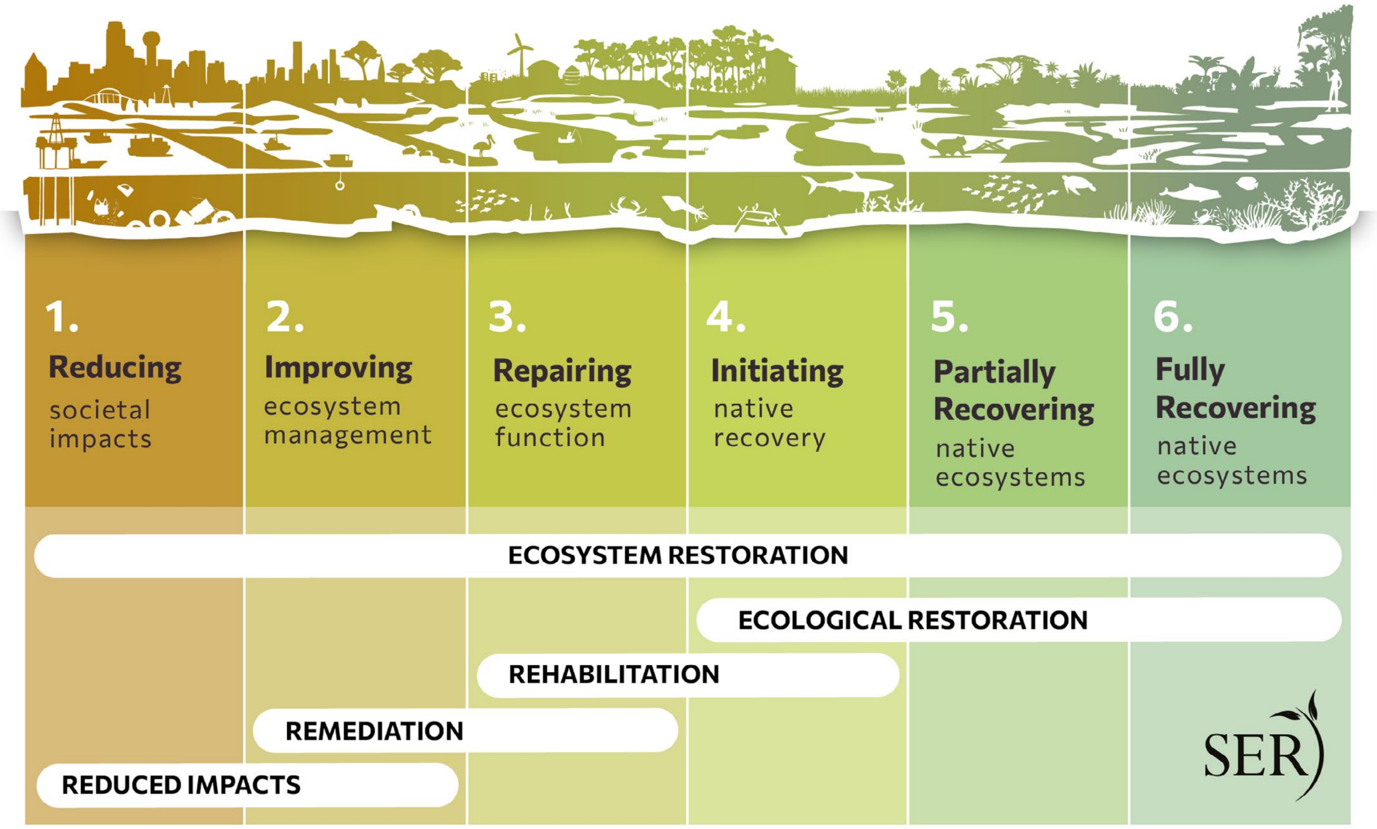
[2] The UN Declaration on the Rights of Indigenous Peoples (UNDRIP) recognizes that respect for Indigenous knowledge, cultures and traditional practices contributes to sustainable and equitable development and proper management of the environment.

The restorative continuum highlights interconnections among different restoration types and activities, and recognizes that both the socioeconomic and ecological contexts of the restoration site inform the selection of the most appropriate restoration actions, with the aim of achieving the highest practicable ambition. As one moves from left to right on the continuum, outcomes for biodiversity, ecological integrity, and quantity and quality of ecosystem services from natural ecosystems increase. Because of the need to provide livelihoods and reduce poverty, significant restoration work is imperative on the left-hand side of the continuum in urban, rural and production landscapes. Note that ecological restoration, the restoration of natural ecosystems, can occur in urban, agricultural and industrial landscapes.

The restorative continuum includes four main categories of restorative activities:

1 Reduction of negative impacts, such as pollution, use of invasive species, and unsustainable resource use and management;
2 Removal of contaminants, pollutants and other threats, often known as remediation;
3 Rehabilitation of ecosystem functions and services in highly modified areas such as former mining sites and degraded production ecosystems, which supports the recovery of biodiversity and ecosystem integrity; and
4 Ecological restoration, which aims to remove degradation and assists in recovering an ecosystem to the trajectory it would be on if degradation had not occurred, accounting for environmental shifts including climate change. Full recovery of natural ecosystems requires reaching a high integrity condition for six key ecological attributes: absence of threats, physical conditions, species composition, structural diversity, ecosystem function and external exchanges (Gann *et al*., 2019).

Figure 2.1 The restorative continuum.


1. Reducing societal impacts
2. Improving ecosystem management
3. Repairing ecosystem function
4. Initiating native recovery
5. Partially Recovering native ecosystems
6. Fully Recovering native ecosystems
ECOSYSTEM RESTORATION
ECOLOGICAL RESTORATION
REHABILITATION
REMEDIATION
REDUCED IMPACTS
SER

Note: The restorative continuum includes a range of activities and interventions that can reverse ecosystem degradation and landscape fragmentation, leading to enhanced biodiversity and ecosystem functions and services, ecological integrity and connectivity, and thus contribute to Target 2.
Source: Adapted from Gann, G. D., McDonald, T., Walder, B., Aronson, J., Nelson, C. R., Jonson, J., Hallett, J. G., Eisenberg, C., Guariguata, M. R., Liu, J., Hua, F., Echeverría, C., Gonzales, E., Shaw, N., Decleer, K., & Dixon, K. W. 2019. International principles and standards for the practice of ecological restoration. Second edition. Restoration Ecology 27(S1): S1–S46. https://doi.org/10.1111/rec.13035

BOX 2.1 Restoration terminology helper —

a review of key concepts and their relationship with the objectives of the KM-GBF

This glossary considers the nuances of restoration by reviewing several key concepts related to restoration and explaining how they intersect and differ (adapted from CBD & SER, 2019).

Restoration — The term restoration, in the broad sense, is generally consistent with the definition of ecosystem restoration (below) but can also be used to refer to ecological restoration, Forest Landscape Restoration, or other even broader concepts, some of which have an even stronger emphasis on human well-being.

Ecosystem restoration — This is the process of halting and reversing degradation, resulting in improved ecosystem services and recovered biodiversity. Ecosystem restoration encompasses a wide continuum of practices, depending on local conditions and societal choice (UNEP, 2021; FAO *et al*., 2021). See also *Principles for ecosystem restoration to guide the United Nations Decade 2021–2030* (FAO *et al*., 2021).

Ecological restoration — This is one part of a broad array of restorative management activities that are considered ecosystem restoration under the UN Restoration Decade (Fig. 3.2). Ecological restoration is broadly defined as the process of assisting in the recovery of an ecosystem that has been damaged, degraded or destroyed (adapted from Gann *et al*. (2019). It differs from other ecosystem restoration activities in that it aims to recover a natural ecosystem or landscape to the condition it would be in had degradation not occurred, while allowing for environmental change (such as increases in temperature or variation in precipitation patterns caused by climate change). Ecological restoration seeks to recover biodiversity and ecosystem integrity, while delivering ecosystem services and ensuring human well-being. The conservation and restoration of biodiversity is a primary outcome.

Land Degradation Neutrality (LDN) — This term is defined by the UNCCD as "a state whereby the amount and quality of land resources necessary to support ecosystem functions and services to enhance food security remain stable, or increase, within specified temporal and spatial scales and ecosystems."

Rehabilitation — Rehabilitation entails management actions that reinstate attributes of some physical properties (e.g. soils, water) and a level of ecosystem functioning on degraded or transformed sites, along with a renewed and ongoing provision of a level of ecosystem services. Native biodiversity and ecosystem integrity are supported but actions do not achieve substantive recovery of a natural ecosystem.

Restoration ecology — This branch of ecological science provides concepts, models, methodologies and tools for the practice of ecological restoration. It also benefits from direct observation of, and participation in, restoration practice. (Gann *et al*., 2019)

Restorative continuum — This is the range of ecosystem restoration activities ordered based on the degree to which they recover biodiversity, ecosystem health and integrity, and human well-being. At one end of this continuum are management activities aimed at reducing societal impacts, such as runoff into urban streams, and mitigating threats such as contaminated soils. The other end of the continuum includes ecological restoration, which aims to both remove degradation and recover ecosystems to the condition they would be in had degradation not occurred, while allowing for environmental change. (Gann *et al*., 2019, Nelson *et al*., 2024)

Indigenous Peoples' biocentric restoration — Indigenous Peoples' biocentric and biocultural restoration are recognized as inclusive and rights-based, and grounded in the knowledge of territorial management of Indigenous Peoples. From a biocentric perspective, Indigenous Peoples place their cosmogony and belief systems, the environment, and biodiversity at the centre of their restoration practices, in both natural and semi-natural ecosystems (Nelson *et al*., 2024).

Rewilding — This is the process of rebuilding a natural ecosystem following major human disturbance. It entails restoring natural processes and the complete or near complete food web at all trophic levels as a self-sustaining and resilient ecosystem with biota that would have been present had the disturbance not occurred (Carver *et al*., 2021). Some consider rewilding to be a unique component of ecological restoration, while others consider it to be its own discipline.

Landscape and seascape approaches — These are integrated and holistic management frameworks that acknowledge the interconnectedness of ecosystems, requiring holistic strategies that consider ecological, social and economic factors. They address the complex mosaics of natural areas, managed ecosystems, communities, uses and infrastructures through an iterative and collaborative process in a consistent and locally sensitive manner, with the goal of restoring biodiversity, maintaining and enhancing ecosystem services, and supporting sustainable human activities (adapted from Bennet *et al.*, 2022; Karimova & Lee, 2022).

Forest (and) landscape restoration (FLR) — The Global Partnership on Forest and Landscape Restoration defines FLR as "a process that aims to regain ecological functionality and enhance human well-being in deforested or degraded landscapes. FLR is not an end in itself, but a means of regaining, improving, and maintaining vital ecological and social functions, in the long-term leading to more resilient and sustainable landscapes." (Besseau *et al*., 2018) Many types of ecosystem restoration interventions are used to implement FLR, which aims to improve both ecological and social conditions across a mosaic of land uses. The same principles used for FLR could be deployed for riverscapes, seascapes and other areas dominated by inland waters or marine ecosystems.

Riverscape (as applied to restoration) — A riverscape is a spatially complex and hierarchically organized system of ecosystems within a river continuum that can be the target of restoration. It represents the mosaic of different habitat types and environmental gradients found in fluvial (river) systems. Dendritic (branching) networks connect these mosaics, resulting in distinctive spatial configurations and structures that set riverscapes apart from most terrestrial and other aquatic systems. A riverscape is a dynamic and interconnected network of habitats that is critical for maintaining connectivity, ecological balance, providing natural infrastructure, and mitigating the effects of natural disasters. (adapted from Brierley & Fryirs, 2022, Skidmore & Wheaton, 2022)

Seascape (as applied to restoration) — These large, multiple-use marine and coastal areas have been scientifically and strategically defined and managed using an integrated approach, emphasizing ecosystem-based management that takes into account ecological, social, cultural and economic factors in order to conserve and restore marine biodiversity and abundance, while also promoting human well-being. Robust monitoring and evaluation frameworks are necessary to support effective governance structures to achieve sustainable and adaptive seascapes that respect local cultures by requiring collaboration among a wide range of stakeholders, including governments, non-governmental organizations (NGOs), local communities and the private sector (adapted from Atkinson *et al.*, 2011, Murphy *et al.*, 2021).

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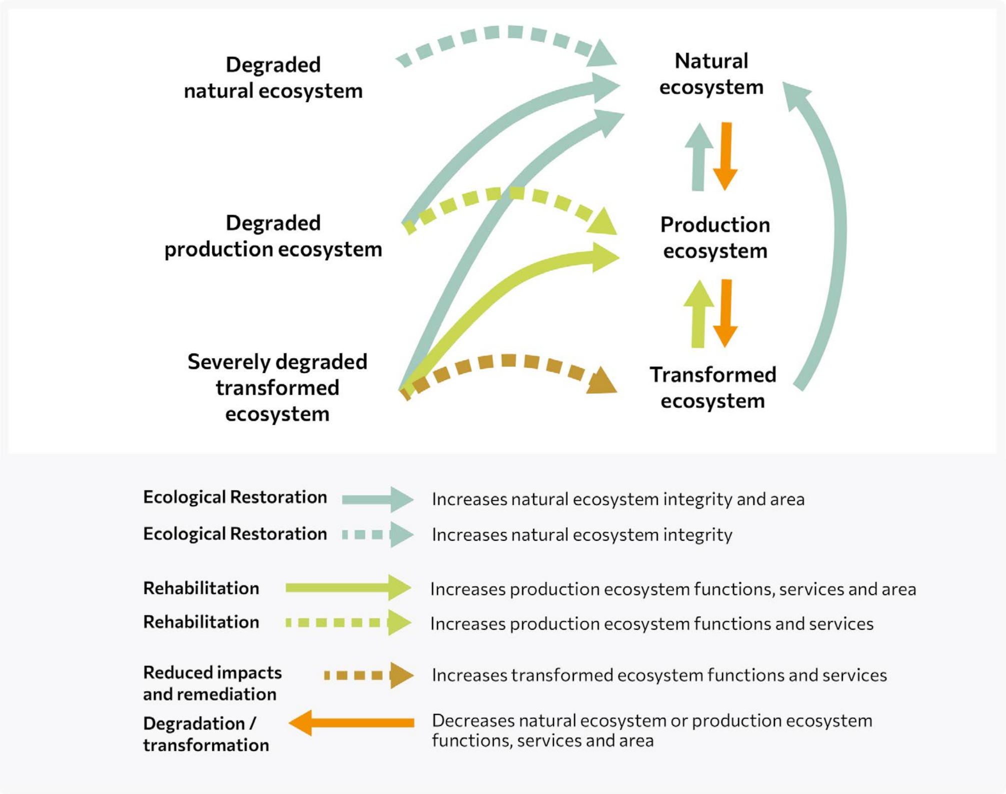
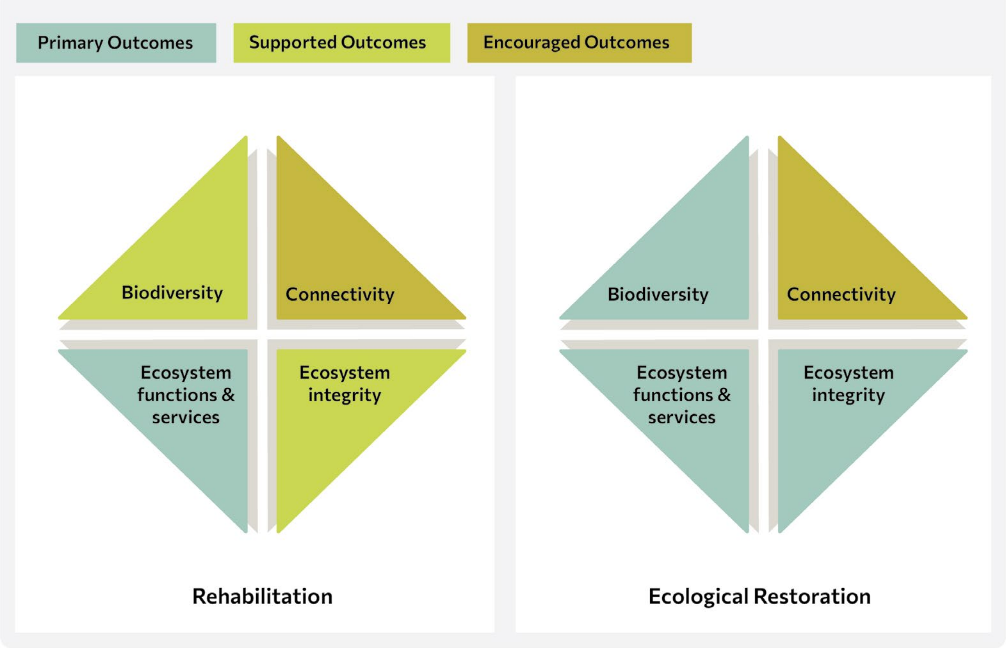
Different major types of restoration will yield different outcomes and benefits for people and nature (Gann *et al*., 2019, Leadley *et al*., 2022, Fig. 2.2, Fig. 2.3). Rehabilitation occurs when the primary outcome is the improvement of some physical properties (e.g. soils, water) and the ecosystem functions together with the provision of ecosystem services that also support biodiversity and ecosystem integrity. Ecological restoration leads to the recovery of natural or semi-natural ecosystems. The reduction of negative environmental and social impacts, or pressures, and the remediation of contamination are also important to the extent that they assist directly or indirectly in the recovery of natural and production ecosystems, biodiversity and ecosystem integrity. Individual sites, projects or programmes may utilize different types of restoration to achieve their intended outcomes. Importantly, the spatial extent of natural areas can only be increased through the ecological restoration of transformed or converted areas. However, all types of restoration are needed and highly valued, and they intersect and complement each other at the landscape and seascape scale. When choosing the type or types of restoration to implement, it is important to consider the highest level of impact that can be effectively achieved at that site, given societal goals.

Figure 2.2 Relationships and transitions between major land use types based on implementation of different ecosystem restoration types, ongoing degradation and transformation.


Degraded natural ecosystem
Natural ecosystem
Degraded production ecosystem
Production ecosystem
Severely degraded transformed ecosystem
Transformed ecosystem
Ecological Restoration
Increases natural ecosystem integrity and area
Ecological Restoration
Increases natural ecosystem integrity
Rehabilitation
Increases production ecosystem functions, services and area
Rehabilitation
Increases production ecosystem functions and services
Reduced impacts and remediation
Increases transformed ecosystem functions and services
Degradation / transformation
Decreases natural ecosystem or production ecosystem functions, services and area

Source: Authors' own elaboration.

Figure 2.3 Rehabilitation and Ecological Restoration in the context of the Target 2 required outcomes.


Primary Outcomes
Supported Outcomes
Encouraged Outcomes
Biodiversity
Connectivity
Ecosystem functions & services
Ecosystem integrity
Rehabilitation
Biodiversity
Connectivity
Ecosystem functions & services
Ecosystem integrity
Ecological Restoration

Note: Within the context of the four major outcomes of Target 2, the two main restoration types, rehabilitation and ecological restoration, yield different outcomes. Rehabilitation results in enhanced ecosystem functions and services while supporting biodiversity and ecosystem integrity. At the same time, ecological restoration results in enhanced biodiversity, ecosystem functions and services, and ecosystem integrity. In both cases, connectivity is restored to the extent possible given landscape and seascape opportunities and limitations. Source: Authors' own elaboration.

2.2 Restoration approaches

Approaches to restoration are often described as passive or active, with passive restoration being used to indicate projects primarily utilizing natural regeneration or recovery, and active restoration to indicate projects that reconstruct substrate conditions; utilize planting of trees or other vegetation; introduce or augment wildlife; modify vegetation through logging, thinning or grafting; or manipulate disturbance regimes such as fire and flooding. In practice, few projects are truly passive, and almost all do or should utilize some assistance. As such, restoration approaches occur along a gradient from few interventions other than the removal of sources of degradation, to various levels of assisted recovery, to the complete reconstruction of nearly all key ecosystem attributes (e.g. Gann *et al.*, 2019; Atkinson and Bonser, 2020; Chazdon *et al.*, 2021). It is not unusual for multiple approaches to be used in a single project. Additionally, some approaches can be combined, such as through the practice of applied nucleation, where small patches of vegetation are planted (often trees) that attract dispersers and facilitate establishment of new recruits through natural regeneration, or where dominant 'ecosystem engineers' are utilized in the marine realm to facilitate natural recovery.

While meta-analyses have not shown that reconstruction projects increase the rate of recovery over natural regeneration, these results can be misleading, since different restoration approaches are rarely compared in the same system (Jones, 2018). Successful projects that rely on natural regeneration work best where conditions for recovery are highest (including both the environmental and socioeconomic conditions). Therefore, projects on the reconstruction end of the spectrum are often deployed in areas with the lowest potential for natural recovery, such as following mining or in highly degraded urban or agricultural landscapes. Importantly, nearly all sites require some assistance to achieve the highest outcomes for biodiversity and ecosystem integrity, even in the best conditions. For example, sites that have high connectivity and robust ecosystem function may be missing key species that face barriers to dispersal, such as plants with large seeds. Wildlife, such as butterflies or birds, may not recover because required larval hosts or food sources are absent from the ecosystem under restoration. Epiphytes, key habitat for myriad species, have been shown to be very slow to recolonize restoration sites. Nevertheless, the general idea is to do the least amount of work needed and to focus efforts on supporting the natural recovery potential of species and ecosystems.

Rights-based approaches must also be considered when working with Indigenous Peoples as rights and knowledge holders. For example, the Indigenous Peoples' biocentric restoration initiative is a holistic restorative approach based on Indigenous Peoples' food and knowledge systems, culture, cosmogony and spiritual belief systems, which are interrelated and interconnected. This approach recognizes the collective and customary rights of Indigenous Peoples, including the right to a free, prior and informed consent (FPIC). It also bases restoration on their collective work, involving communities and households in conservation and restoration activities.

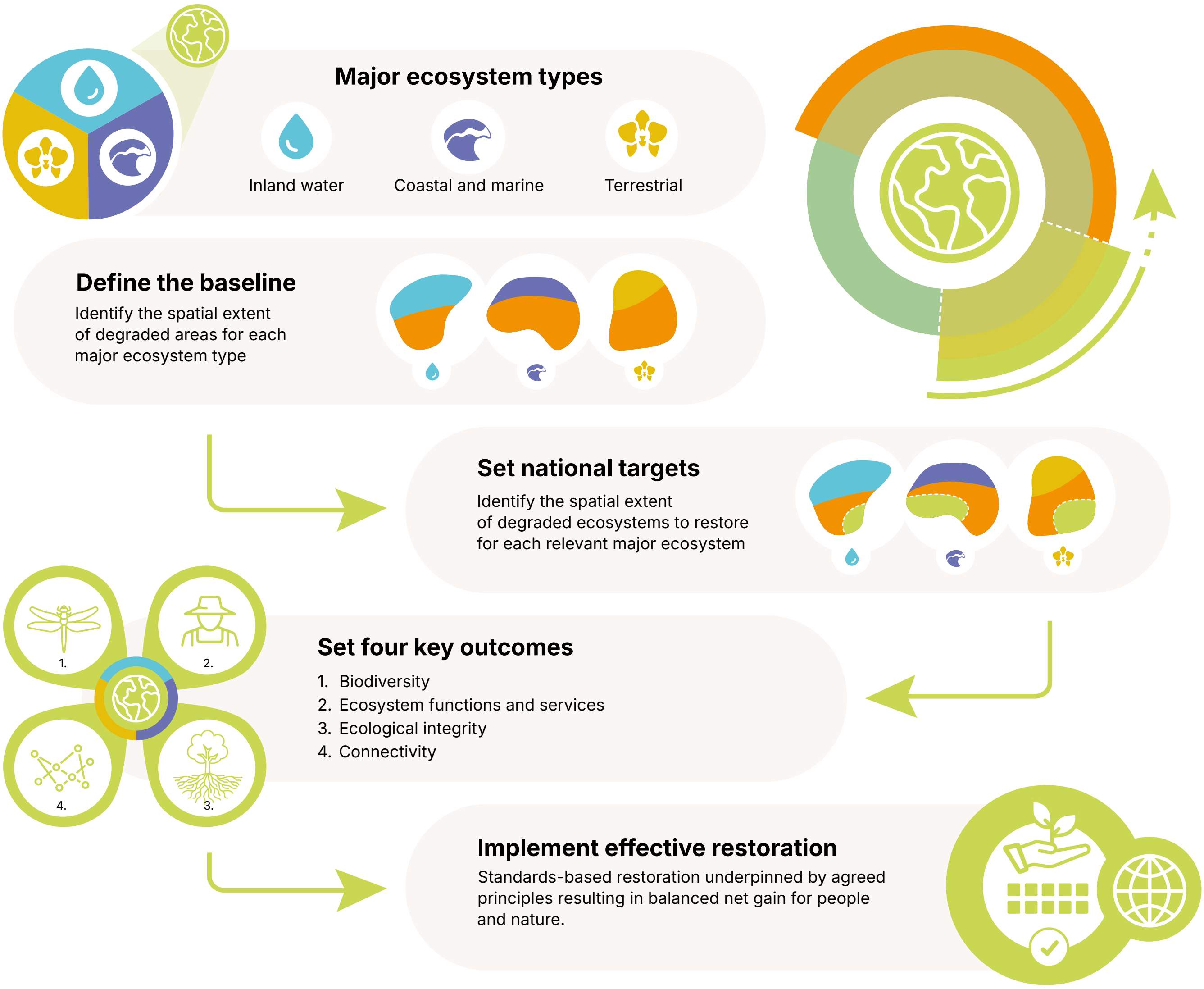
The most appropriate method to use in a given location depends on a series of factors such as: degree of degradation or transformation; ecological context; landscape and seascape context; potential for recovery; and the desires, expectations and capabilities of the communities that take part in or are affected by the restoration. Based on conditions and overarching goals, Parties may prioritize different approaches in order to achieve certain objectives, such as the recovery of threatened biodiversity or the delivery of clean water. Ultimately, restoration types and approaches are best balanced to meet the dual needs of nature and human well-being. General guidance for prioritizing restoration approaches can be found in sections 3 and 6.1, and in the assessment sections of the STAPER and the UN Restoration Decade Standards of Practice (SOPs) (Nelson *et al.*, 2024).

3. THE KEY ELEMENTS OF TARGET 2

Target 2 calls for at least 30 percent of areas of degraded terrestrial, inland water, and coastal and marine ecosystems to be under effective restoration by 2030. This is the global target.

The key elements of Target 2 are: define the baseline, set national targets, define restoration outcomes, and apply principles of effective restoration across all major ecosystem types (Fig. 3.1).

Figure 3.1 The Key Elements of Target 2.


Major ecosystem types
Inland water
Coastal and marine
Terrestrial
Define the baseline
Set national targets
Set four key outcomes
1. Biodiversity
2. Ecosystem functions and services
3. Ecological integrity
4. Connectivity
1.
2.
3.
4.
Implement effective restoration

Identify the spatial extent of degraded areas for each major ecosystem type

Identify the spatial extent of degraded ecosystems to restore for each relevant major ecosystem

Standards-based restoration underpinned by agreed principles resulting in balanced net gain for people and nature.

Note: The key elements of Target 2 are interrelated and can largely be considered sequential. The first steps are to define the baseline and then set national targets. Once those targets are set, consider the four key outcomes (biodiversity, ecosystem functions and services, ecological integrity, and connectivity), and then design and implement effective restoration plans to achieve a balanced net gain for people and nature. Optimally, these steps are separated by major ecosystem types.
Source: Authors' own elaboration

3.1 Define the baseline

In the context of the KM-GBF and Target 2, in line with the CBD COP Decision 15/5 (monitoring framework), the baseline for setting up the ambition of targets should be defined by a country taking into account historical trends, current status and future scenarios. The period 2011-2020 should be used to establish the baseline where data are available for monitoring and reporting purposes. The baseline is the spatial extent of degraded areas within a country at the end of the baseline period, disaggregated by major ecosystem type. The concept of degradation, however, is context-dependent (Annex A), and defining degradation and establishing baseline conditions was a major challenge in implementing the Aichi Biodiversity Targets. Table 3.2 describes key definitions of degradation that are of relevance to Target 2.

Table 3.1 Examples of definitions of degradation of relevance to Target 2.

Source	Definition of Degradation	Measure of Degradation
Red List of Ecosystems	Defines ecosystem degradation as the inverse of ecosystem integrity. Ecosystem integrity is defined as the degree to which an ecosystem's physical condition, composition, structure and function are intact.	Ecosystem degradation — integrity
STAPER	A decline or loss of biodiversity or ecosystem functions, which is context-specific, referring to both the state of ecosystems and to ecosystem processes.	Ecosystem degradation — integrity
System of Environmental Economic Accounting (SEEA-EA)	The decrease in the value of an ecosystem asset over an accounting period that is associated with a decline in the condition of an ecosystem asset during that accounting period.	Ecosystem degradation — condition
UNCCD, Land Degradation Neutrality (LDN) and SDG Indicator 15.3.1	The loss of biological or economic productivity and complexity in agricultural, range or forest land due to processes arising from human activities, such as the erosion or deterioration of soil and the loss of natural vegetation. *115 countries reported values of degraded land, and when combined with 52 national estimates generated by the UNCCD, resulted in an annual degradation rate of at least 100 million hectares (ha) between 2015 and 2019.	Land degradation — productivity and complexity

Source	Definition of Degradation	Measure of Degradation
UN Restoration Decade SOPs	A persistent deterioration of ecosystem attributes (e.g. abiotic condition, species composition, ecosystem structure and function, external exchanges) relative to reference conditions, due to direct (e.g. unsustainable resource use, land use change, overexploitation, contamination) or indirect (e.g. climate change) human intervention, that affects the ecosystem's capacity to provide benefits to people and nature.	Ecosystem degradation — all aspects

Source: Authors' own elaboration.

Because degradation can take many forms and be measured in different ways, there are varying estimates on the amount of degraded habitat globally. However, estimates suggest that between 20 and 40 percent of the global land area alone could be considered degraded (UNCCD, 2022b), affecting the well-being of at least 3.2 billion people (IPBES, 2018). Freshwater wetlands and other inland waters are particularly degraded, with about 23 percent of remaining wetlands reported to be in a highly degraded ('poor') state in 2020 (Simpson *et al.*, 2021). Over 50 percent of rivers globally are estimated to be impaired or severely impaired (Feio, 2022). Marine ecosystems are also experiencing high rates of loss and degradation, particularly along coastlines and for critical fisheries. Estimates are that only 3 percent of the world's oceans are not impacted by humans (Obura, 2021), and more than 40 percent have been strongly impacted (Halpern, 2008). This degradation has resulted in more than 1 million species of animals and plants being threatened with extinction, along with significant reductions in ecosystem functions and services (IPBES, 2019).

Because of the context-specific nature of degradation, it is important to understand the national circumstances surrounding degradation, drivers of degradation and what ecosystems are being degraded. Degradation and degradation drivers are also measured in different ways across different ecosystem types. This is true not only between natural and production ecosystems, but also between the major ecosystem types identified in Target 2: terrestrial, inland water, and coastal and marine. In the absence of a global standard, it is critical that policy-makers agree on a definition of and metrics

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for 'degraded' at the country or ecosystem level (Bell-James *et al.*, 2024). Wherever possible, pre KM-GBF baseline conditions should be documented, making use of assessment methodologies such as in the IUCN Red List of Ecosystems or SDG Indicator 15.3.1, as appropriate (see also Section 6.1). In addition, it is important to acknowledge the concept of shifting baselines, where conditions have declined over long periods of time. Some ecosystems may be more degraded than commonly thought, and sometimes current observers view ecosystems as non-degraded that previous observers would view as degraded (Gann *et al.*, 2019). In these cases, the description of accurate reference conditions may require careful analysis (Bell-James *et al.*, 2024). It is important to incorporate Indigenous Peoples' perspectives and Indigenous Peoples' ecological knowledge when defining degradation and establishing baseline conditions, as they have a very deep knowledge and understanding of their land and territories and local environments.

3.2 Set national targets

Target 2 calls for 30 percent of degraded ecosystems to be under restoration globally by 2030. However, each country should set a target for the spatial extent of degraded ecosystems to be placed under restoration within the country, as well as the total extent of each major ecosystem type to be targeted for restoration (see Section 6.1). While Target 2 is based on proportions of degraded major ecosystem types, countries are encouraged to select explicit numeric targets for the country as a whole, disaggregated for terrestrial, inland water, and coastal and marine ecosystems as appropriate, as well as targets for specific individual ecosystems (see Section 6.1 and Box 7.1). Countries may also select linear targets, such as for river restoration. This would assist with the inclusion of other area-based commitments into Target 2 commitments and with Target 2 monitoring.

In some cases, a country may determine that one ecosystem type should be a priority for restoration over another. The assessment of restoration opportunities and priorities based on national circumstances could lead to smaller or larger contributions to the global target by a country, or for major ecosystem types within a country. While there is no requirement that the 30 percent be achieved uniformly across all major types, the concept of ecological representativeness would favour more uniform proportions of restoration across major ecosystem types. In practice, restoration may be concentrated where it is perceived to be more cost-effective or where enabling conditions are more favourable (see case study 3.1). Nevertheless, where practicable the full variety of relevant major natural ecosystem

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types should be included within national restoration targets, optimally aligning with the IUCN Global Ecosystem Typology (GET) (Keith *et al.*, 2020, sections 3.5, 7). Addressing within-ecosystem variation (including species, within-species, and seasonal variation) is also critical for biodiversity and ecosystem integrity outcomes.

The restoration of production ecosystems is also essential to reduce pressure on natural ecosystems and ensure or increase the flow of ecosystem functions and services. In addition to the intrinsic value of biodiversity and ecosystem integrity and connectivity, functions and services may include food supply, wood, fibre and other material products, clean and abundant water resources, natural movement of sediment, disaster prevention, increase in carbon stocks, and climate change adaptation and mitigation (see also IPBES (2019) and SEEA Metadata Fact Sheet for Headline Indicator for Goal B, Services provided by ecosystems).

National targets should also recognize and support restoration efforts led by Indigenous Peoples, ensuring their governance systems and rights are respected and integrated into national strategies. Other key guidance for national target setting can be found in Sections 5 and 6.1 below.

Case study 3.1 Restoring the Murray-Darling Basin

The Murray-Darling Basin is the largest river system in Australia. It is home to 16 internationally significant wetlands, at least 35 endangered bird species and over 120 different species of waterbirds.

Between 1997 and 2009, Australia was affected by one of the worst droughts in its recorded history. This highlighted that too much water was being extracted from the system and not enough remained to sustain river health and provide for critical human needs.

In response, the Australian Government established a legislative framework for managing the basin in the national interest – the Murray-Darling Basin Plan. The plan is bringing the basin environment back to a healthier and more sustainable level while continuing to support farming, industry and communities.

The plan sets limits on how much water can be taken from rivers and groundwater systems for towns, farms and other uses. The remaining water is available for government-led environmental watering activities to restore and maintain the health of rivers, wetlands and floodplains; to preserve biodiversity; and to improve conditions for native wildlife.

The Australian and state governments in the basin deliver water for the environment when and where it is needed to help ecosystems regenerate and thrive. The ecological responses to these activities are monitored and evaluated through on-ground monitoring, research and engagement in selected areas, as well as through basin-scale evaluations.

As a result, since 2009 over 16 000 gigalitres (GL) of water have been delivered to support river and wetland health in the basin. These restoration activities have occurred across more than 26 000 kilometres (km) of waterways, 420 000 hectares (ha) of lakes and floodplains, and 11 internationally significant Ramsar wetlands. They have helped flush more than 4 million tonnes (t) of salt out to sea.

This has buffered the basin's flora and fauna through drought and helped species populations survive until better conditions return. Environmental watering also supports fish spawning and population growth, and major waterbird breeding events.

The Australian Government continues to work with state jurisdictions and organizations to manage the Murray-Darling Basin's resources sustainably and deliver water to the environment to help unique ecosystems thrive.

3.3 Define restoration outcomes

The following outcomes are described in Target 2:

Enhanced biodiversity — Restoration aims to recover biodiversity at all levels including temporal variability, from landscapes and seascapes to ecosystems, communities, species, populations and genes. To prevent both global and local extinctions, special attention must be paid to rare and threatened species, reducing drivers of degradation, improving habitat provisioning and assisting the recovery of depleted populations.

Enhanced ecosystem functions and services — Restoration aims to recover the functions and processes that underpin ecosystems, from natural disturbance regimes to water and nutrient cycling, habitat provisioning, and recruitment and other attributes of resilience. These outcomes pertain to both natural and production ecosystems. It is important to note that restoration targets and plans should be developed to simultaneously achieve beneficial social outcomes, such as reducing poverty and increasing opportunities for high quality livelihoods. While these outcomes could be assumed to be included in ecosystem services, since they are not explicitly mentioned in the key outcomes for Target 2, they require specific attention when developing restoration targets and plans.

Enhanced ecological integrity — Restoration aims to recover the full range of attributes that make up ecosystems, from landforms and soils to water quantity, quality and timing, species composition and structure, and food webs and trophic interactions. Effective restoration also identifies and removes, reduces or mitigates the drivers of degradation that threaten ecosystem integrity in the present and future.

Enhanced ecological connectivity — Restoration aims to improve beneficial ecological connectivity of ecosystems under restoration with nearby ecosystems and across landscapes and seascapes. This includes landscape flows of increased movement of species, flows of water and other large-scale ecological processes; the improvement or provision of habitats for migratory or other mobile species; and improvement of gene flows critical for species survival, resilience and adaptability (see Case Study 3.2).

While some individual restoration projects will help achieve all four restoration outcomes, many will not. For example, due to widespread fragmentation, not all projects that aim to restore natural ecosystems will enhance spatial ecological connectivity. Likewise, the restoration of production ecosystems may focus on attributes that enhance ecosystem functions and services, but biodiversity and ecosystem integrity should be supported, either on site or off site. To the extent practicable, opportunities to address multiple outcomes should be considered.

Restoration priorities should be set at the national, subnational and local levels to ensure that all four outcomes are reasonably balanced across the suite of activities implemented. Integrated spatial planning in line with the KM-GBF Target 1 could be a useful tool that will help to plan various restoration outcomes at the landscape or seascape scale.

Case study 3.2 Connectivity of jaguars (*Panthera onca*) in Latin America

a case study of the Maya Forest Corridor, Belize

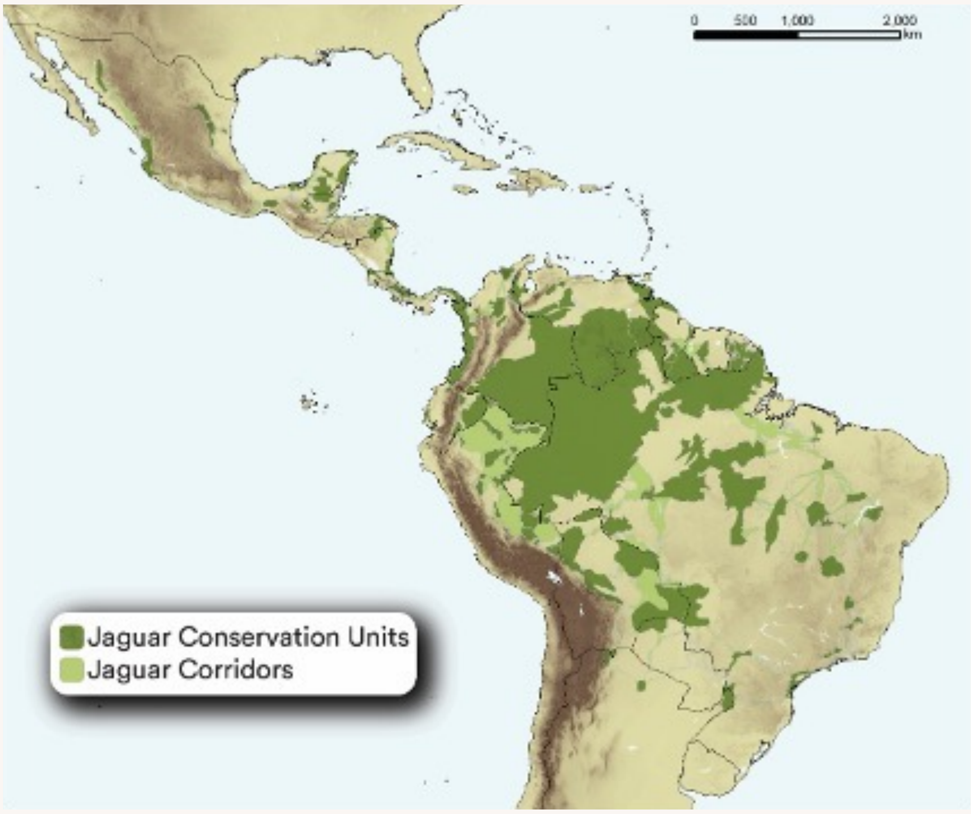
Jaguars *(Panthera onca)* are the third largest wild felid in the world and currently range from Argentina to Mexico. Over 20 years ago, the Wildlife Conservation Society and the Universidad Nacional Autonóma de México formed a group of jaguar experts to develop a comprehensive conservation plan for the species (Hilty *et al.*, 2020). After identifying over 50 core jaguar populations (called Jaguar Conservation Units, or JCUs; Sanderson *et al.*, 2002), a genetic assessment indicated that jaguars are a single species throughout their range (i.e. no subspecies; Eizirik *et al.*, 2001).

The findings inspired Panthera's Jaguar Corridor Initiative (Rabinowitz & Zeller 2010), which aims to maintain and restore physical and genetic connectivity across the entirety of the jaguar range (Figure B1). The Initiative modelled connectivity among JCUs and identified 182 corridors covering 4.5 million km². Sixty-seven percent of JCUs and 46 percent of all corridors were already under some level of protection. A set of criteria helped to prioritize JCUs and corridors, to further guide on-the-ground and range-wide conservation efforts by Panthera (www.panthera.org) and partners. The Jaguar 2030 Roadmap (https://www.internationaljaguarday.org/jaguar-conservation-roadmap; Jaguar 2030 Coordination Committee 2022) is the next chapter in this vision for range-wide jaguar conservation.

A specific case of on-the-ground interventions includes a connectivity model developed for the Maya Forest in Belize. The model included known jaguar locations, habitat suitability of both jaguars and their prey, habitat availability, patch size and configuration, road density and human populations. Because drought, intensified by climate change, is a threat to the resilience of the region, an additional analysis identified areas of concern. The model predicted areas suitable for movement, pinch-points and barriers. One such pinch-point includes the now-protected Maya Forest Corridor, a 10 000 ha (7 km wide and 20 km long) strip of pine forest and wetland that connects a series of protected areas between the Selva Maya and Belize's Maya Mountains. Model outputs such as these help to prioritize areas for conservation interventions to improve connectivity, including safeguarding forest cover, promoting sustainable and drought-resistant agroforestry activities, and reducing barriers to wildlife movement.

Spatial models are key tools for conservation and restoration planning because they help to prioritize areas for conservation planning, management and interventions. The jaguar connectivity models described above offer methods that may be further applied or adapted for range-wide conservation and restoration planning for other 'umbrella' species.

Figure 3.B1: The Jaguar Corridor



Notes: The Jaguar Corridor spans from northern Mexico through northern Argentina and includes core jaguar populations (called Jaguar Conservation Units or JCUS, dark green) and jaguar corridors (light green). The map was formalized in the Jaguar 2030 Roadmap, with updates from jaguar range country experts in 2021 (Jaguar 2030 Coordination Committee 2022).

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3.4 Apply principles of effective restoration

For purposes of the KM-GBF, effective restoration can be defined as standards-based restoration underpinned by agreed principles that results in appropriately balanced sustainable net gain that benefits and enhances biodiversity, ecosystem integrity and human well-being (Box 3.1).

A site, landscape or seascape can be considered under effective restoration beginning with the implementation of restoration activities through ongoing management and monitoring and evaluation, including adaptive management. Effective restoration is a multi-faceted process that must include assessment, planning, implementation, ongoing management, and monitoring and evaluation processes. It should balance the needs and expectations of stakeholders, including the types of ecosystem services they require or expect, the distribution of human populations, the type of infrastructure present or planned, and the types and distributions of natural and production ecosystems in the landscape. Effective restoration should also uphold the rights of Indigenous Peoples to their land and territories, ensuring their free, prior and informed consent is obtained for any restoration activities, as appropriate.

Different types of restoration will achieve different outcomes for Target 2 (Section 2.1). Optimal outcomes, however, are often attained by the integration of these restoration types in a landscape or seascape to (i) directly restore biodiversity and natural ecosystems in locations where that is possible and desirable and (ii) increase ecosystem functions and services; reduce impacts on the ecosystems that support biodiversity; and increase the flow of benefits to biodiversity and natural ecosystems, either on site or off site. Box 3.2 provides attributes of effective restoration for the two major types of restoration that contribute to Target 2, rehabilitation and ecological restoration.

Box 3.1 Guidance and standards to support effective restoration

As described in Section 1, the STAPER provides voluntary step-by-step guidance to support countries in the development and implementation of their NBSAPs. Although approved during the Strategic Plan for Biodiversity 2011-2020 period, the STAPER is still relevant today. The STAPER established principles for ecosystem restoration related to the CBD process and described four main groups of key activities that could be undertaken by Parties in collaboration with other relevant actors:

a assessment of opportunities for ecosystem restoration;
b improving the institutional enabling environment for ecosystem restoration;
c planning and implementation of ecosystem restoration activities; and
d monitoring, evaluation, feedback and disseminating results.

These four main groups of activities were broken down into 24 steps that were further supported in the STAPER Companion, produced with the support of the Forest Ecosystem Restoration Initiative (FERI) of the Republic of Korea (CBD and SER, 2019). The STAPER Companion is hosted by the FERI website with case studies and additional guidance, and links to the Restoration Resource Center hosted by the Society for Ecological Restoration (SER). In 2022, the STAPER was also used as a key document in the development of a Massive Open Online Course on Ecosystem Restoration hosted by the United Nations Development Programme (UNDP) and the CBD.

Also released at COP 13 was the first version of SER's Principles and Standards for the Practice of Ecological Restoration, which were updated in 2019 (SER Standards; Gann *et al*., 2019). The SER Standards provide voluntary guidance on the restoration of natural and semi-natural landscapes. They introduced the restorative continuum (Fig. 2.1), and include eight Principles for ecological restoration, standards of practice for ecological restoration projects and other key guidance. These principles and standards, and those for the UN Restoration Decade described below, align with the Conservation Standards, which are widely used by conservation practitioners and policymakers worldwide.

The UN Restoration Decade, through its Best Practices Task Force, developed Principles (FAO *et al*., 2022, Fig 3.2) and SOPs (Nelson *et al*., 2024) for ecosystem restoration. The UN Restoration Decade SOPs are linked to the 10 Principles, and are based on five major components (assessment, planning and design, implementation, ongoing management and monitoring and evaluation), 45 subcomponents and dozens of individual practices.

Biome and sector-based standards and guidelines are being released on a regular basis (Section 6, Annex E). While global principles and standards are needed for global and national planning, biome and sector-based standards are extremely useful at the landscape, seascape and project scale.

Sources:

CBD and SER. 2019. A companion to the short-term action plan on ecosystem restoration - resources, case studies, and biodiversity considerations in the context of restoration science and practice. CBD Secretariat and Society for Ecological Restoration. https://www.cbd-feri.org/staper

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Box 3.2. Attributes of effective rehabilitation and ecological restoration

Effective rehabilitation projects:

- focus on repairing ecosystem functions and delivering ecosystem services;
- address the causes of degradation to the extent possible;
- avoid damage to natural ecosystems or other biodiversity assets;
- aim for a net benefit to the systems that support biodiversity;
- incorporate local native species if appropriate to the context;
- follow a plan or strategy informed by restoration science and practice;
- have measurable goals and objectives and implement a monitoring plan including social and ecological indicators;
- are adaptable (and adapted) to changing environmental conditions and new information;
- address the values of both nature and people and meaningfully engage a broad diversity of stakeholders;
- seek cost-effective solutions to make the most of limited resources.

Example: *An oil spill causes significant damage to offshore oyster reefs. The oyster reefs are a production ecosystem, parts of which are leased to private entities for the purpose of regular harvesting of native oysters, and other parts for seeding new oysters to the privately leased plots. To recover from the damage caused by the oil spill, the oyster seeding habitat is rebuilt by adding cultch material (crushed limestone, concrete or oyster shell) to the public sections. This method is an accepted practice in this region, and restoring the oyster seeding habitat also benefits other native species. The project is monitored for the success of oyster establishment, and this monitoring is considered when future cultch deposition projects are planned and implemented. This project* ***is effective rehabilitation*** *since it repairs ecosystem function (oyster establishment) in a manner that also benefits native biodiversity and ecological integrity.*

Activities that would not be considered effective rehabilitation include those that:

- only improve ecosystem services without providing at least some net benefit to the systems that support biodiversity;
- modify or create levels of ecosystem function that are so dissimilar to natural local conditions that the project would be considered a type of transformation rather than a type of restoration (e.g. highly enriching the chemical or physical properties of native soils for agriculture or redirecting natural water flows for the purposes of agriculture); and
- introduce or foster invasive species.

Example: *A project plants several thousand tree seedlings with various soil and water treatments to determine the best combination for carbon sequestration. This project takes place in a semi-arid and sparsely vegetated shrub- and grassland landscape. They find that a non-native Eucalyptus species offers advantages over native species. Eucalyptus is then planted in large plantations with high inputs of irrigation and soil amendments. This project* ***is not effective rehabilitation*** *even though it provides an ecosystem service (carbon sequestration). It does not benefit native biodiversity or integrity, it introduces a potentially invasive species, and it relies on modifying the native soils and diverting water to a great extent.*

Effective ecological restoration projects:

- address the causes of degradation to the extent possible;
- avoid damage to native ecosystems or other biodiversity assets;
- aim for the highest practicable ecological restoration outcome;
- are informed by the attributes of an appropriate native reference model;
- follow a restoration plan or strategy informed by restoration science and practice;
- utilize approaches and treatments well matched to the ecological condition of the site that support its potential to recover;
- have measurable goals and objectives and implement a monitoring plan including social and ecological indicators;

- are adaptable (and adapted) to changing environmental conditions and new information;
- optimize ecological connectivity, to the extent practicable;
- address the values of both nature and people and meaningfully engage a broad diversity of stakeholders; and
- seek cost-effective solutions to make the most of limited resources.

Example: *A river with a watershed of 2 000 km^2 is drastically altered as part of a large-scale project to create productive agricultural land. The river is channelized and disconnected from its floodplain. Three decades later, these alterations are reversed, with the intention of restoring native biodiversity and ecological integrity. The work successfully reinstates the river's natural flooding cycle, which supports the return of many native species while improving livelihoods and engaging stakeholders. A large part of the watershed is made into a new protected area with ongoing support to protect and maintain the biodiversity and ecological integrity of the watershed. This project is designed and implemented based on reference models developed from historic and contemporary information, including data from reference sites. This project* ***is effective ecological restoration*** *because it addresses the causes of degradation with appropriate treatment; is informed by an appropriate native reference model; and includes a primary focus on the benefits to native biodiversity and ecological integrity, while also improving human well-being.*

Activities that would not be considered effective ecological restoration include those that:

- introduce or foster invasive species;
- use species that are not part of the local natural ecosystem reference model (unless there is a particular ecological justification);
- use appropriate species without sufficient genetic diversity for them to breed effectively or adapt to changing ecological conditions;
- undertake treatments without adequate follow-up and ongoing management;
- do not accommodate the potential for natural regeneration to be realized in the long term or, where possible, harnessed in the short term;
- do not address or mitigate causal factors; and
- ause harm to native ecosystems.

Example: *A former mine site is regraded; treated with soil amendments; and reseeded with a mix of native grasses, shrubs, and trees. The species selected are based on several neighbouring temperate woodland reference sites. The primary goal of this project is to restore biodiversity and ecological integrity to the sites. The site is left without being monitored for more than a decade. Then it is discovered that the site is still in a degraded and grass-dominated state instead of recovering the typical characteristics of the woodland target state. This was caused by a combination of insufficient initial seeding rates of woody plant species and the illegal harvesting of the woody plant species that grew. This project* ***is not effective ecological restoration*** *because it failed to implement monitoring and ongoing management plans, even though it used a native reference ecosystem as a model and aimed to support native biodiversity and ecological integrity.*

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Figure 3.2 Principles that underpin the United Nations Decade on Ecosystem Restoration.

PRINCIPLE 1
Ecosystem restoration contributes to the UN Sustainable Development Goals and the goals of the Rio Conventions

PRINCIPLE 2
Ecosystem restoration promotes inclusive and participatory governance, social fairness and equity from the start and throughout the process and outcomes

PRINCIPLE 3
Ecosystem restoration includes a continuum of restorative activities

PRINCIPLE 4
Ecosystem restoration aims to achieve the highest level of recovery for biodiversity, ecosystem health and integrity, and human well-being

PRINCIPLE 5
Ecosystem restoration addresses the direct and indirect causes of ecosystem degradation

PRINCIPLE 6
Ecosystem restoration incorporates all types of knowledge and promotes their exchange and integration throughout the process

PRINCIPLE 7
Ecosystem restoration is based on well-defined short-, medium- and long-term ecological, cultural and socioeconomic objectives and goals

PRINCIPLE 8
Ecosystem restoration is tailored to the local ecological, cultural and socioeconomic contexts, while considering the larger landscape or seascape

PRINCIPLE 9
Ecosystem restoration includes monitoring, evaluation and adaptive management throughout and beyond the lifetime of the project or programme

PRINCIPLE 10
Ecosystem restoration is enabled by policies and measures that promote its long-term progress, fostering replication and scaling-up

Source: FAO. 2021. The white/wiphala paper on Indigenous Peoples' food systems. FAO. https://openknowledge.fao.org/server/api/core/bitstreams/3462ba89-ea23-4d49-a3bf-e64bdcc83613/content

3.5 Across all major ecosystem types

Target 2 identifies three major ecosystem types, each with special considerations for restoration: terrestrial, inland water, and coastal and marine. In addition, the restoration of transformed production ecosystems is essential to maintaining the provision of ecosystem services required for human well-being (Section 2.1, Fig. 2.3). Many natural and semi-natural ecosystems are also production ecosystems, thus combining features of more than one group. However, assessing, planning, implementing and monitoring restoration in these different ecosystem types to achieve the Target 2 objectives represents a challenge. For example, the communities of policymakers, practitioners and scientists working in these different ecosystem types may not typically work together. In addition, those working on ecological restoration in degraded natural ecosystems are often isolated from those working on rehabilitation in production landscapes. Best practice would be to integrate restoration across these types through spatial planning (Target 1) that also considers and integrates restoration in protected areas, OECMs and Indigenous Territories (Target 3) and in landscapes, watersheds or seascapes being utilized for agriculture, forestry, fisheries and other production uses (Target 10).

Natural ecosystems are subject to pressure from human activities, and the main direct and indirect drivers of their degradation vary according to major ecosystem type. Many drivers of degradation also endanger human groups, including Indigenous Peoples, whose territories suffer from the direct and indirect impact of degradation (Riget *et al.*, 2019). The main direct drivers of degradation in terrestrial, inland water and coastal ecosystems are the expansion of crop and grazing lands into natural ecosystems; unsustainable agricultural, aquacultural and forestry practices; overharvesting; and urban expansion, infrastructure development and extractive industries in specific areas (IPBES, 2018; Convention on Wetlands, 2021b). Pollution (e.g. toxic chemicals and other contaminants), direct exploitation (eg. use of water for human activities), and climate change (e.g. warming temperatures) are also major drivers of degradation in inland water and coastal ecosystems. In marine ecosystems, direct exploitation such as overexploitation of fisheries, land-sea change linked to events like the destruction of coral and shellfish reefs, and climate change (e.g. warming temperatures) are major drivers of degradation. Loss of natural ecosystems through transformation, coupled with degradation of the remaining natural ecosystems, is the leading cause of biodiversity loss across all major natural biomes. However, invasive alien species and climate change are expected to increasingly drive losses in biodiversity (IPBES, 2018, Pereira *et al.*, 2024). Ecosystems affected by degradation include terrestrial forests, mangroves, savannas, grasslands, rivers, lakes and other wetlands including peatlands, marine shelfs and coral reefs, and production ecosystems such as croplands and rangelands. Ecosystems in the arctic at high latitudes and elevations are especially affected by degradation exacerbated by climate change. Indigenous Peoples' territories are particularly vulnerable to drivers of degradation, highlighting the need for their active involvement and leadership in restoration efforts to ensure the protection and recovery of these critical ecosystems.

Several ecosystem typologies and classifications have been proposed at the global level (e.g. IUCN GET, FAO Land Cover Classification System) and could be used to improve the effectiveness of restoration at the country level. This could help countries plan, implement and monitor restoration at the highest degree of precision practicable. In some cases, this may be at the biome or functional group level as described by the GET, a comprehensive classification framework for Earth's ecosystems that integrates functional and compositional features. Finer scales, however, are recommended, such as spatially explicit nationally defined ecosystem typologies, or subnational or local ecosystem classification systems. Preferably, countries can align their nationally defined ecosystem types with GET ecosystem functional groups, and aggregate subnational and local ecosystem classification systems into national and GET classification systems (see Case Study 3.3, Section 7).

The three major ecosystem types have both common (e.g. diversity of threats) and unique (e.g. composition, function) attributes, which should be considered when planning and implementing restoration. In addition, there are significant differences in the state of knowledge associated with these ecosystems and their restoration. Fig. 3.3 provides a collation of some differences that exist in terms of both opportunities and challenges for delivery of Target 2 objectives across differing major ecosystem types. Finally, restoration in production ecosystems has its own unique attributes and considerations.

Case study 3.3 Exploring the classification of ecosystem types in Viet Nam

as a basis for assessing conservation status and implementing restoration activities

Currently, Viet Nam does not have a comprehensive, systematic, unified, consistent and detailed ecosystem classification system. This has led to difficulties in research, monitoring and policy development for biodiversity conservation and restoration. A recent study conducted in 2024 aimed to identify ecosystem types across Viet Nam by functional group and at the provincial scale using the new IUCN Global Ecosystem Typology (GET). Through this approach, 60 ecosystem functional groups were identified, including 45 natural ecosystem functional groups and 15 transformed ecosystem functional groups. By applying this classification system in Quang Ninh Province, located in the northeast region of Viet Nam, the study recorded 44 out of 60 ecosystem functional groups. The study shows the high level of ecosystem diversity in this country. However, the high level of diversity also poses a challenge in attempting to subdivide the ecosystem functional groups into more detailed levels. Below the level of ecosystem functional groups (level 3), Viet Nam has not yet developed a system to classify ecosystems into more detailed levels (levels 4 to 6). Currently, Vietnamese scientists often use the forest classification system with nine basic forest ecosystems (Trung, 1999) or four main forest types as in the Circular No. 33/2018/TT-BNNPTN issued by the Ministry of Agriculture and Rural Development. For wetland ecosystems, the Ministry of Natural Resources and Environment's Circular dated 31 August 2020 has identified 26 types of wetlands in Viet Nam. This wetland classification system follows the classification system of the Ramsar Convention on Wetlands. Based on the functional group analysis, the study further showed that most of Viet Nam’s terrestrial ecosystems suffer from at least one form of degradation, spanning from low to high levels, with high fragmentation and weak connectivity, most severely being felt in inland aquatic ecosystems. More effort is needed to undertake the classification of Viet Nam's ecosystems beyond level 3, with active capacity development and training required to classify and identify the conservation status of ecosystems moving forward. Although a novel approach, it provides an important basis for countries such as Viet Nam to target and implement effective ecosystem restoration activities in line with the ambitious targets of the KM-GBF.

Source: Trung, T.V. 1999. Tropical forest ecosystems in Viet Nam. Science and Technology Publishing House.

Coastal and marine ecosystems — There is a large, and somewhat complex, international legal framework for conserving and sustainably using marine biodiversity, which includes instruments such as the UN Convention on the Law of the Sea, the CBD and the Ramsar Convention on Wetlands. This international framework provides a strong basis for not only protecting marine ecosystems from damage, but also restoring marine ecosystems that have been degraded. However, working in marine and coastal areas can be complicated by several factors. The greater the horizontal and vertical distance (i.e. the deep sea) from land, the more difficult it is to engage communities and the public in all aspects of restoration. This distance also limits accessibility, which results in less available information about marine ecosystem conditions, restoration needs and restoration opportunities as compared to both inland waters and terrestrial systems. Area measurements are complex in marine environments, creating challenges for applying and measuring the 30 percent target. Extensive development and modifications of coastlines make work in coastal areas challenging, although these areas may also be highly regulated. The fluidity and connectivity of marine systems creates unique opportunities and challenges for restoration (e.g. propagules travel much farther and can support restoration, but so do contaminants.)

Degradation threats include overfishing, coral bleaching, shellfish die off, kelp deforestation, chemical contamination, plastic pollution, and water quality, quantity and temperature changes.

Figure 3.3: A comparison of major ecosystem types in terms of key restoration factors as they relate to Target 2.

Knowledge

	Terrestrial
Inherent ecosystem properties	🟩 Ecosystems well characterized
	🟩 Intra-ecosystem variability understood
	🟨 Ecosystem dynamics understood
	🟩 Ecosystem vulnerability characterized
Condition	🟨 Ecosystem condition known
	🟩 Ecosystem component status known
Connectivity	🟩 Land-habitat links understood
	🟩 Land-water links understood
	🟩 Dynamics of interlinkages understood
Degradation drivers and threats	🟩 Surface and subsurface resources are highly regulated
	🟥 Large-scale degradation processes (e.g. deforestation, desertification, conversion, temperature)
	🟥 High diversity of pressures
	🟥 Synergistic pressures

Restoration considerations

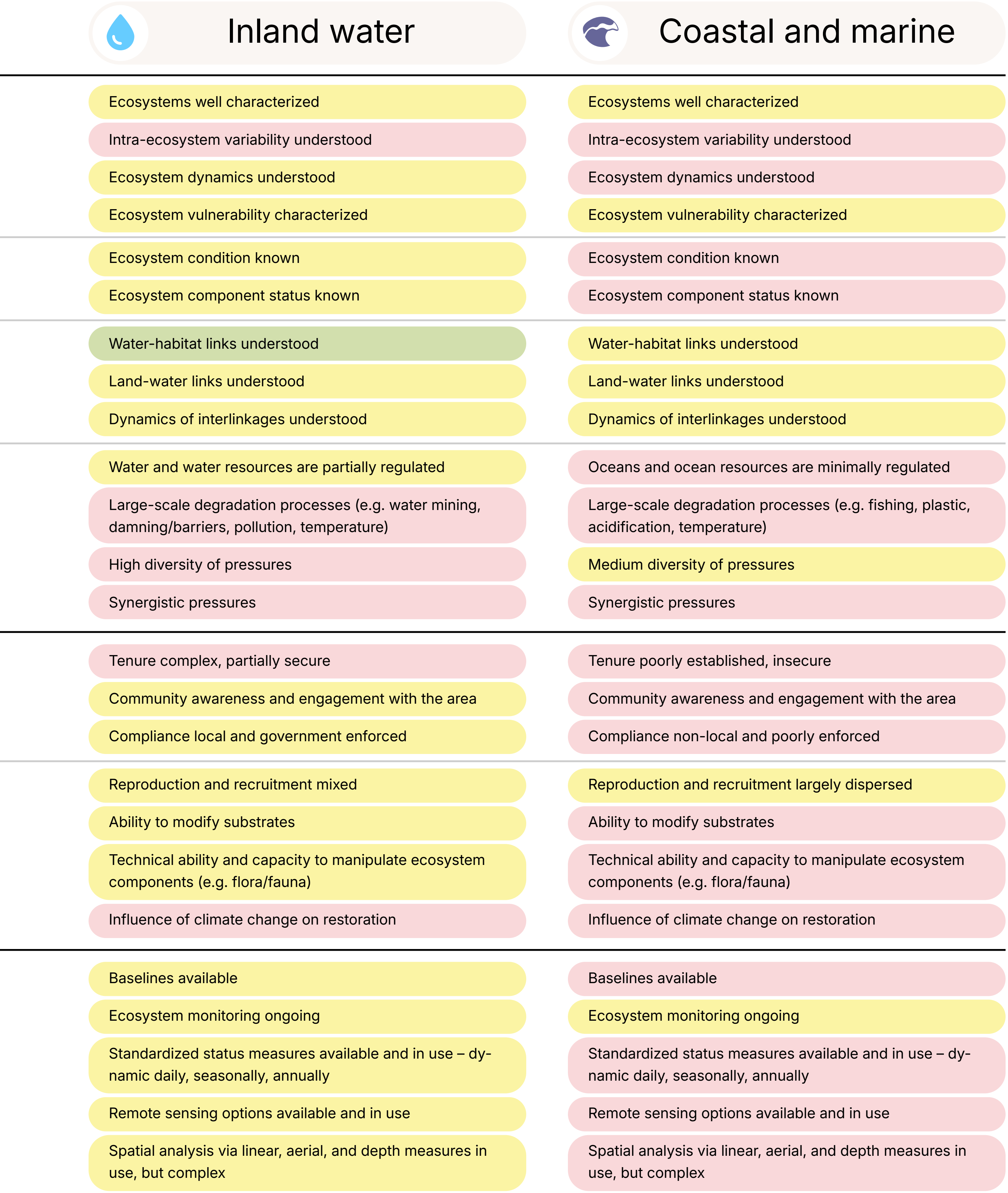
Socio-political	🟨 Tenure partially documented, partially secure
	🟨 Community awareness and engagement with the area
	🟨 Compliance local and government enforced
Ecological/Technical	🟩 Reproduction and recruitment largely local
	🟩 Ability to modify substrates
	🟩 Technical ability and capacity to manipulate ecosystem components (e.g. flora/fauna)
	🟥 Influence of climate change on restoration

Measurements

🟨 Baselines available
🟨 Ecosystem monitoring ongoing
🟩 Standardized status measures available and in use – dynamic daily, seasonally, annually
🟨 Remote sensing options available and in use
🟨 Spatial analysis via area, linear, and structural measures established

🟩 **Green**	Knowledge and strengths exist
🟥 **Red**	Many unknowns and challenges exist
🟨 **Yellow**	Mixed

Notes: An earlier draft was produced by the Inland Waters and Coastal and Marine Group during the workshop Developing a Roadmap for the Kunming-Montreal Global Biodiversity Framework Target 2. Items in green are areas for which knowledge and strengths exist, or for which notable progress has been accomplished; pink indicates areas with significant unknowns or challenges, while yellow is a mix of the two.
Source: Authors' own elaboration.



Inland water	Coastal and marine
🟨 Ecosystems well characterized	🟨 Ecosystems well characterized
🟥 Intra-ecosystem variability understood	🟥 Intra-ecosystem variability understood
🟨 Ecosystem dynamics understood	🟥 Ecosystem dynamics understood
🟨 Ecosystem vulnerability characterized	🟨 Ecosystem vulnerability characterized
🟨 Ecosystem condition known	🟥 Ecosystem condition known
🟨 Ecosystem component status known	🟥 Ecosystem component status known
🟩 Water-habitat links understood	🟨 Water-habitat links understood
🟨 Land-water links understood	🟨 Land-water links understood
🟨 Dynamics of interlinkages understood	🟨 Dynamics of interlinkages understood
🟨 Water and water resources are partially regulated	🟥 Oceans and ocean resources are minimally regulated
🟥 Large-scale degradation processes (e.g. water mining, damning/barriers, pollution, temperature)	🟥 Large-scale degradation processes (e.g. fishing, plastic, acidification, temperature)
🟥 High diversity of pressures	🟨 Medium diversity of pressures
🟥 Synergistic pressures	🟥 Synergistic pressures
🟥 Tenure complex, partially secure	🟥 Tenure poorly established, insecure
🟨 Community awareness and engagement with the area	🟥 Community awareness and engagement with the area
🟨 Compliance local and government enforced	🟥 Compliance non-local and poorly enforced
🟨 Reproduction and recruitment mixed	🟨 Reproduction and recruitment largely dispersed
🟨 Ability to modify substrates	🟥 Ability to modify substrates
🟨 Technical ability and capacity to manipulate ecosystem components (e.g. flora/fauna)	🟥 Technical ability and capacity to manipulate ecosystem components (e.g. flora/fauna)
🟥 Influence of climate change on restoration	🟥 Influence of climate change on restoration
🟨 Baselines available	🟥 Baselines available
🟨 Ecosystem monitoring ongoing	🟨 Ecosystem monitoring ongoing
🟨 Standardized status measures available and in use – dynamic daily, seasonally, annually	🟥 Standardized status measures available and in use – dynamic daily, seasonally, annually
🟨 Remote sensing options available and in use	🟥 Remote sensing options available and in use
🟨 Spatial analysis via linear, aerial, and depth measures in use, but complex	🟥 Spatial analysis via linear, aerial, and depth measures in use, but complex

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Inland waters — Inland waters include lakes, wetlands, riverscapes, peatlands, groundwater and other aquatic systems within terrestrial areas. While they can include saline and brackish waters, in the CBD context inland waters largely refers to freshwater. Although the Ramsar Convention on Wetlands estimates that wetlands are the most threatened major ecosystem type globally, distinguishing between specific kinds of wetlands remains a major challenge. Like marine ecosystems, inland waters often fall under common jurisdiction, which creates significant challenges and add complexity to planning, funding and implementing restoration. Furthermore, the diversity of standards levels among countries, in terms of water bodies' quality assessment, represents an additional difficulty in assessing the effectiveness of inland water restoration. The linear nature of some inland waters must be taken into consideration when defining and achieving area-based targets. Degradation and ecosystem integrity can be measured through changes in ecological attributes, including ecological connectivity, species richness (e.g. presence or abundance of key species, diversity of relevant species groups), and physical and chemical water conditions (e.g. water availability and quality), as well as shifts in timing. While much is known about restoration in inland waters, data sharing and availability can be comparatively lower than for some terrestrial ecosystems, such as forests. Moreover, the case of groundwater is particularly problematic, as some countries know little about its extent and condition. Land-use change is a significant driver of degradation. Other threats include chemical contamination; water quality, quantity and temperature changes; impediments to flow (e.g. dams), and overharvesting (e.g. for irrigation) and overuse.

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Terrestrial — While terrestrial restoration is often considered to be the major ecosystem type with the most knowledge, inputs, and activities, that knowledge is inconsistent across terrestrial ecosystems. Forest ecosystems generally receive the most attention, including research and data availability. However, terrestrial ecosystems are incredibly diverse and require many different approaches and activities. The need for rehabilitation on extraction sites (i.e. mines) and production lands is also extensive in the terrestrial realm.

Key threats include land use change, deforestation, desertification, fire, drought, overgrazing, extensive agriculture, chemical and toxic pollution, and invasive species.

Production — While opportunities for restoration in production landscapes is extensive, this is an area that needs more work. The rehabilitation of agricultural land and soil is needed as well as the ecological restoration of production ecosystems, based on native and semi-natural ecosystems from native forests managed for wood production, to rangelands utilizing native grasslands, to semi-natural hayfields, to fisheries in inland waters and marine ecosystems. Opportunities for rehabilitation include agroforestry systems and other agroecological systems based on regenerative and sustainable principles. Threats include urbanization and other land use change, loss of soil quality, pollution and invasive species.

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4. GLOBAL INITIATIVES ALIGNED WITH TARGET 2

Ecosystem restoration contributes to the 2030 Sustainable Development Goals (SDGs) and a wide number of other global policies and agreements (International Resource Panel, 2019; UN Restoration Decade Strategy). The UN Restoration Decade Strategy outlines the expected contributions of ecosystem restoration during the decade to a wide variety of policies and multilateral environmental agreements (MEAs).

In addition, the recent CBD information paper (CBD/SBI/4/INF/13), "Key entry points for cooperation and collaboration among multilateral environmental agreements," cross-maps the KM-GBF to the Aichi Biodiversity Targets and 13 other MEAs. Major intersections of Target 2 exist with SDGs (including 6.6, 14.2, 15.1 and 15.3); the Paris Agreement adopted under the United Nations Framework Convention on Climate Change (UNFCCC); the Land Degradation Neutrality targets supported by the United Nations Convention to Combat Desertification (UNCCD); the Ramsar Convention on Wetlands (Strategic Plan Targets 8 and 12); the Sendai Framework for Disaster Risk Reduction 2015-2030; the Bonn Challenge, which was originally based on Aichi Biodiversity Target 15; and New York Declaration on Forests targets of restoring 350 million hectares of degraded land by 2030. Like the UN Restoration Decade, Target 2 also intersects with the World Heritage Convention, the Convention on the Conservation of Migratory Species of Wild Animals, the UN Strategic Plan for Forests, the UN Convention on the Law of the Sea, REDD+ under the UNFCCC, Stockholm Convention on Persistent Organic Pollutants, and the Regional Seas Conventions. It will also complement the UN Decade of Family Farming (2019–2028), the International Decade for Action on Water for Sustainable Development (2018–2028), and the UN Decade of Ocean Science for Sustainable Development (2021-2023; Section 4.2). Coordination mechanisms have been established by the UN Restoration Decade's lead agencies, the FAO and UNEP. Additional initiatives are described in Section 6.2. Global initiatives should recognize and support Indigenous Peoples-led restoration efforts, promoting the inclusion of Indigenous Peoples' knowledge and governance systems in international restoration frameworks.

4.1 The United Nations Decade on Ecosystem Restoration 2021-2030

In 2019, the United Nations proclaimed 2021–2030 the United Nations Decade on Ecosystem Restoration (UN Restoration Decade), with the primary aim being to prevent, halt and reverse the degradation of ecosystems worldwide. Notably, the UN Restoration Decade envisions "a restored relationship between humans and nature," emphasizing the need for transformative change. Examples of restoration activities in the UN Restoration Decade Strategy (2020) include enhancing organic carbon in agricultural soils, increasing fish stocks in overfished zones, remediating polluted sites, restoring ecological processes, and restoring biodiversity and conserving fauna and flora that can assist in the restoration process.

The UN Restoration Decade is led by FAO and UNEP, and the CBD Secretariat is a collaborating agency.

Working through its five task forces (best practices, finance, monitoring, science, youth), the UN Restoration Decade offers an inclusive communication and experience-sharing platform to support and celebrate restoration action around the globe.

The UN Restoration Decade has issued Principles and Standards of Practice for ecosystem restoration to support its operationalization (see Section 3.2). Through its World Restoration Flagships, the UN Restoration Decade seeks to honour high impact examples of large-scale and long-term ecosystem restoration, embodying the 10 Principles of the UN Restoration Decade. While the UN Restoration Decade does not itself have a formal target, it urges countries to meet their restoration commitments made through the different MEAs and other global initiatives with restoration targets or components. A major aim of the UN Restoration Decade is to build linkages and support those commitments, recently estimated at over 1 Bha (Van der Esch *et al.*, 2022). Coordination mechanisms have been established by FAO and UNEP. The UN Decade on Ecosystem Restoration includes work focused on the role of Indigenous Peoples' food and knowledge systems in addressing biodiversity loss and highlighting the benefits of biocentric restoration and other approaches led by Indigenous Peoples.

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4.2 The United Nations Decade of Ocean Science for Sustainable Development 2021-2030

The UN Decade of Ocean Science for Sustainable Development 2021-2030 (UN Ocean Decade) has strong links to ecosystem restoration (UNESCO, 2021b). Outcome 2 for the 'ocean we want' is "A healthy and resilient ocean where marine ecosystems are understood, protected, restored and managed." Outcome 2 acknowledges that priority knowledge gaps of ecosystems and their reactions to multiple stressors need to be filled. This is particularly true where multiple human stressors interact with climate change, including issues such as acidification and temperature increase.

Challenge 2 of the UN Ocean Decade, a Knowledge and Solutions Challenge, is: Understand the effects of multiple stressors on ocean ecosystems and develop solutions to monitor, protect, manage and restore ecosystems and their biodiversity under changing environmental, social and climate conditions.

UN Ocean Decade programmes tightly aligned with ecosystem restoration include The Global Ocean Decade Programme for Blue Carbon; The Global Coastal Ocean Restoration and Resilience; and programmes on sea ice, kelp, mangrove and coral restoration. Indigenous Peoples' knowledge systems and territorial management practices are vital for the restoration and sustainable management of marine ecosystems. Therefore, their involvement should be prioritized in the UN Ocean Decade initiatives.

5. INTEGRATING TARGET 2 INTO NATIONAL BIODIVERSITY TARGETS AND UPDATED NBSAPS

National Biodiversity Strategies and Action Plans (NBSAPs) are key national policy instruments for planning and implementing the Convention on Biological Diversity and its decisions, optimally prepared in an integrated, multi-sectoral process underpinned by broad participation by stakeholders and rights and knowledge holders.

NBSAPs are a key component of the planning, monitoring, reporting and review mechanisms of the KM-GBF and document how a country intends to fulfil commitments made to the CBD. They also include action or implementation plans, along with finance and capacity development plans. Tools and guidance are available to support the NBSAP process (Box 2.1). CBD COP Decision 15/6 requested Parties to revise and update their NBSAPs by COP 16 in 2024. The NBSAPs should include national targets and align with the KM-GBF, encompassing all goals and targets. They should also encompass all goals and targets, by CBD COP 16 in 2024. Updating the NBSAPs marks one of the first steps in the process to achieve the KM-GBF 2030 targets and 2050 goals (Fig. 5.1).

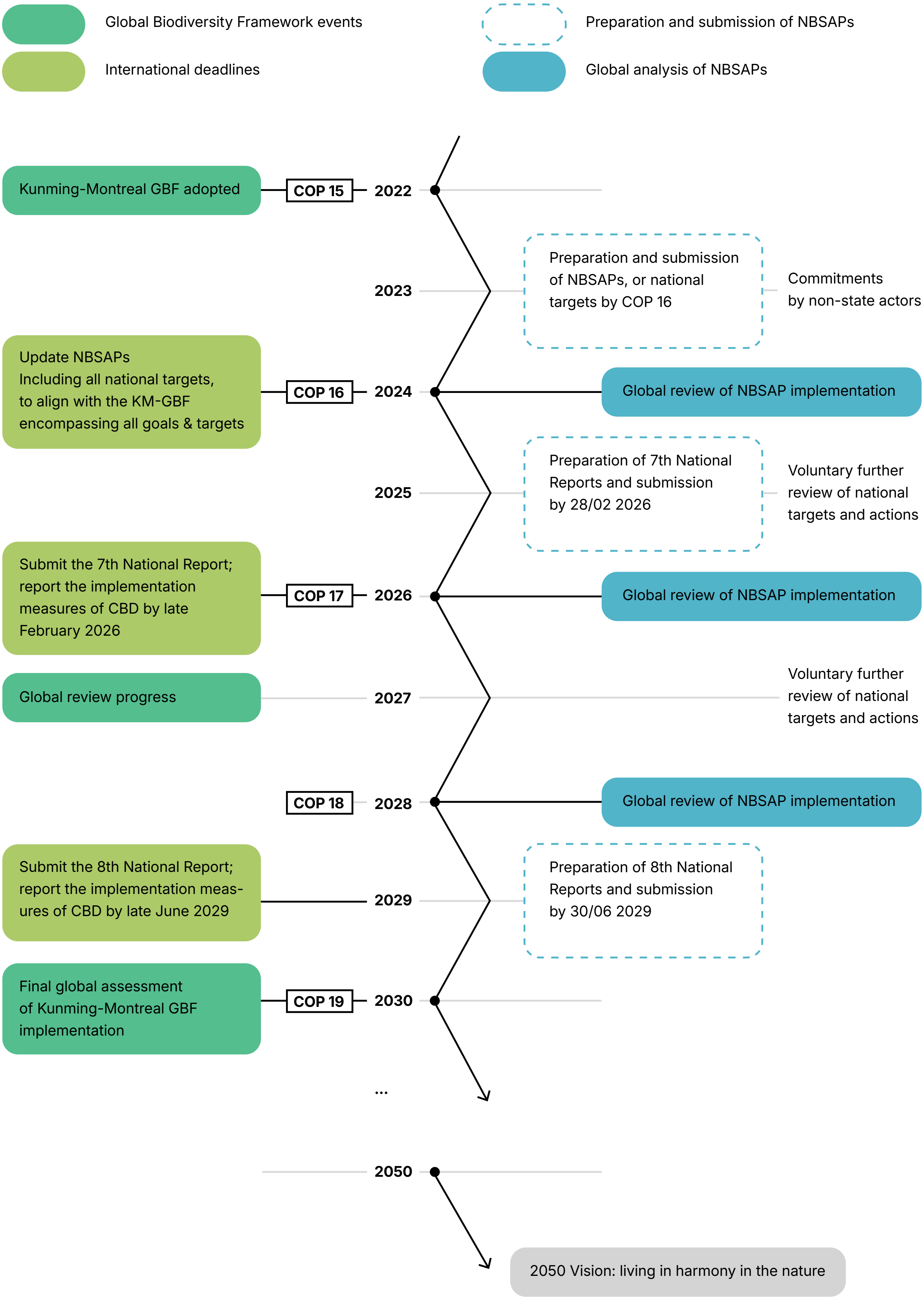
Where possible, NBSAPs are formally adopted as policy or within the legal or administrative framework of countries, and integrated with "national sustainable development plans, national development plans, poverty reduction strategies, and other relevant national sectoral and cross-sectoral plans, in line with national circumstances and priorities" (CBD/COP/DEC/15/6). For effective restoration implementation to occur, however, national policies must be translated and applied at the sub-national, local and even project scales. Please also refer to Sections 3.4 and 6.

BOX 5.1 National Biodiversity Strategy and Action Plan tools and guidance.

In accordance with Annex I of CBD COP Decision 15/6, the CBD provides tools and guidance to assist countries to update NBSAPs and accelerate national efforts towards meeting goals and targets of the KM-GBF. These include:

- SCBD maintains quick guides for the KM-GBF, including Target 2, and a series of NBSAP capacity building modules.
- SCBD, UNDP, and UNEP host the NBSAP Forum, a global partnership with the UNDP, UNEP and GEF designed to assist countries to find the information they need to develop and implement effective NBSAPs and prepare national reports on their effectiveness.
- The Global Biodiversity Framework Early Action Support (GBF-EAS) is a government-led, GEF-funded project available to GEF-eligible Parties to the CBD to accelerate KM-GBF preparedness and implementation this decade. Using a technical document, it helps 138 developing, small island and middle-income nations align their NBSAPs with the KM-GBF financially and technically.
- Providing additional support, the NBSAP Accelerator Partnership aims to accelerate the implementation of NBSAPs aligned with the KM-GBF.
- Additional guidance for specific topics, such as ecological connectivity, have also been developed. See Annex E.

Figure 5.1 The Kunming-Montreal Global Biodiversity Framework timeline.


Global Biodiversity Framework events
Preparation and submission of NBSAPs
International deadlines
Global analysis of NBSAPs
Kunming-Montreal GBF adopted
COP 15
2022
2023
Preparation and submission of NBSAPs, or national targets by COP 16
Commitments by non-state actors
Update NBSAPs Including all national targets, to align with the KM-GBF encompassing all goals & targets
COP 16
2024
Global review of NBSAP implementation
2025
Preparation of 7th National Reports and submission by 28/02 2026
Voluntary further review of national targets and actions
Submit the 7th National Report; report the implementation measures of CBD by late February 2026
COP 17
2026
Global review of NBSAP implementation
Global review progress
2027
Voluntary further review of national targets and actions
COP 18
2028
Global review of NBSAP implementation
Submit the 8th National Report; report the implementation measures of CBD by late June 2029
2029
Preparation of 8th National Reports and submission by 30/06 2029
Final global assessment of Kunming-Montreal GBF implementation
COP 19
2030
...
2050
2050 Vision: living in harmony in the nature

Source: Authors' own elaboration

5.1 Incorporating key components of Target 2 into National Biodiversity Strategies and Action Plans

Restoration targets should be set and planned as part of the overall NBSAP process. Actions to reach Target 2 should consider all factors for implementation identified in Section C of the KM-GBF (CBD 2024, Annex C). Focusing on the contributions of biodiversity and ecosystem services, countries must define clear, measurable actions; gather resources; forge partnerships; and build capacity for achieving concrete outcomes of restoration activities (FAO, 2023). Planners should take advantage of the stakeholder and rights and knowledge holder engagement process with Indigenous Peoples, as included in section C of the KM-GBF. They should also collaborate with teams working on other targets to mainstream restoration into all sectors (see Section 5.3 below). Some countries are creating participatory intersectoral spaces to encourage and support this process.

Restoration activities should be integrated into national finance and capacity development plans.

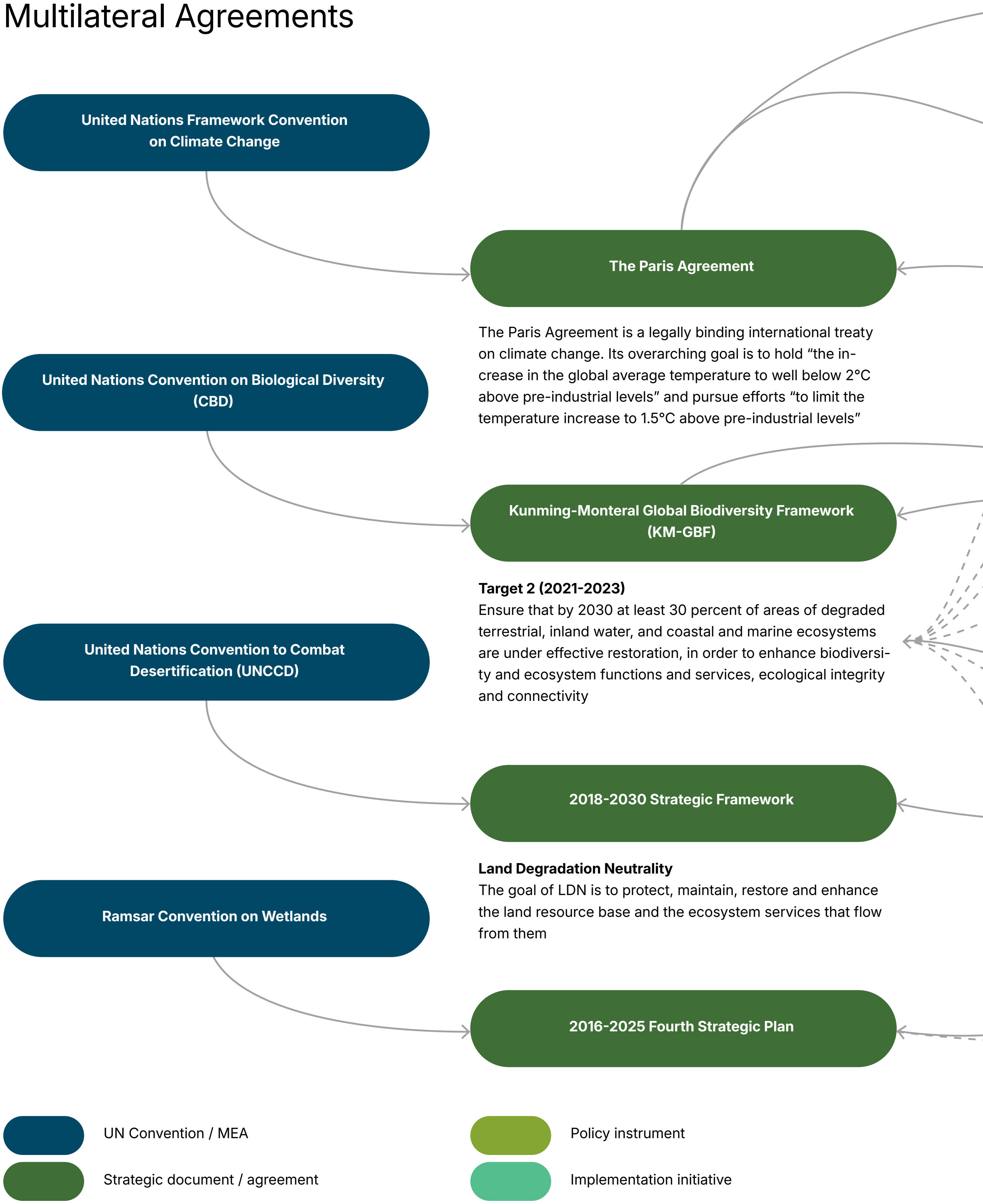
Key to the NBSAP process is the development of a finance plan or similar instrument, including a budget for developing or revising the NBSAP and a budget to carry out the priority actions identified in the strategy (CBD/COP/DEC/15/7).

In addition, a capacity development plan is needed to ensure that the organizational and technical skills needed to develop and implement the NBSAP are available, recognizing the role of multi-country regional organizations in developing capacity and science-technical cooperation (see Box 11 in KM-GBF EAS technical support guidance). In addition to training, capacity development must include provision of the tools and guidance needed to effectively carry out NBSAPs, whether those are developed at the national or global levels. This includes tools and guidance that recognize and incorporate Indigenous Peoples' knowledge systems and territorial management practices, ensuring that restoration efforts are culturally appropriate and effective.

The enabling factors, challenges, and lessons learned from "The Strategic Plan for Biodiversity 2011–2020 and its Aichi Biodiversity Targets" can help countries develop new, achievable national targets, including for restoration, to include in their updated NBSAPs. Experts should review past NBSAPs and report what was achieved, what was not, and why. For Target 2, national targets and NBSAPs can be revised primarily from Aichi Biodiversity Target 15, but also from Aichi Targets 5, 14 and others. Countries may also draw from experiences planning for the Bonn Challenge, AFR100, REDD+, LDN, or other related national commitments (Fig. 5.2, Section 4). Optimally, current restoration commitments in other MEAs are included and counted toward KM-GBF Target 2 commitments.

Figure 5.2 Relationship of the KM-GBF Target 2 to other national commitments.

Restoration Map: Intersecting Initiatives from Different Multilateral Agreements



United Nations Framework Convention on Climate Change

The Paris Agreement

The Paris Agreement is a legally binding international treaty on climate change. Its overarching goal is to hold "the increase in the global average temperature to well below 2°C above pre-industrial levels" and pursue efforts "to limit the temperature increase to 1.5°C above pre-industrial levels"

United Nations Convention on Biological Diversity (CBD)

Kunming-Monteral Global Biodiversity Framework (KM-GBF)

Target 2 (2021-2023)
Ensure that by 2030 at least 30 percent of areas of degraded terrestrial, inland water, and coastal and marine ecosystems are under effective restoration, in order to enhance biodiversity and ecosystem functions and services, ecological integrity and connectivity

United Nations Convention to Combat Desertification (UNCCD)

2018-2030 Strategic Framework

Land Degradation Neutrality
The goal of LDN is to protect, maintain, restore and enhance the land resource base and the ecosystem services that flow from them

Ramsar Convention on Wetlands

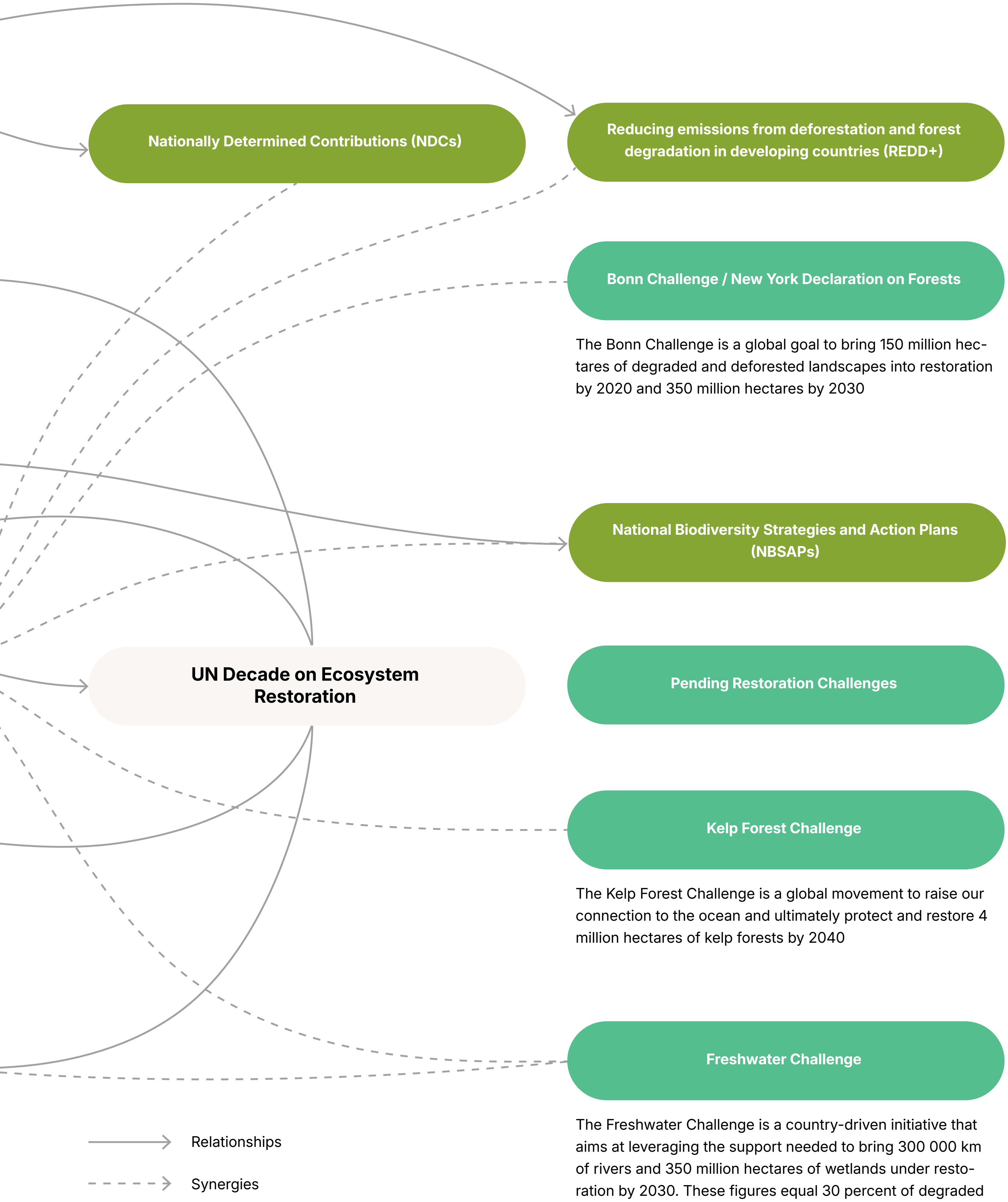
2016-2025 Fourth Strategic Plan

🟦 UN Convention / MEA

🟩 Strategic document / agreement

🟩 Policy instrument

🟩 Implementation initiative



Nationally Determined Contributions (NDCs)

Reducing emissions from deforestation and forest degradation in developing countries (REDD+)

Bonn Challenge / New York Declaration on Forests

The Bonn Challenge is a global goal to bring 150 million hectares of degraded and deforested landscapes into restoration by 2020 and 350 million hectares by 2030

National Biodiversity Strategies and Action Plans (NBSAPs)

UN Decade on Ecosystem Restoration

Pending Restoration Challenges

Kelp Forest Challenge

The Kelp Forest Challenge is a global movement to raise our connection to the ocean and ultimately protect and restore 4 million hectares of kelp forests by 2040

Freshwater Challenge

The Freshwater Challenge is a country-driven initiative that aims at leveraging the support needed to bring 300 000 km of rivers and 350 million hectares of wetlands under restoration by 2030. These figures equal 30 percent of degraded freshwater ecosystems

→ Relationships

⇢ Synergies

Source: Authors' own elaboration

5.2 Linkages to the Kunming-Montreal Global Biodiversity Framework goals and other targets

Well coordinated NBSAPs require the recognition of linkages between different targets (Fig. 5.3), increasing efficiency and outcomes and allowing for a balance of trade-offs, such as those between the ecological objectives of Target 2 and the need to deliver production and ecosystem services to meet the needs of people in Targets 10 and 11. NBSAPs also contribute to the overarching goals of the KM-GBF, especially Goal A about maintaining, enhancing, and restoring natural ecosystems; reducing extinctions; and maintaining genetic diversity, and Goal B on nature's contributions to people. To date, most NBSAPs have focused on conservation measures, such as increasing national systems of protected and conserved areas, avoiding or minimizing destruction or degradation of habitats by reducing drivers of degradation, and reducing pressures on threatened species. However, updating and revising the NBSAPs provides an opportunity to integrate restoration across the KM-GBF. For example, integrating effective ecosystem restoration activities of Target 2 with the conservation and management of protected and conserved areas, OECMs, and Indigenous Territories in Target 3 can reduce the risk of extinction of threatened species as highlighted in Target 4.

All KM-GBF targets are interdependent and need concrete actions, policies and programmes to meet national and global goals and priorities.

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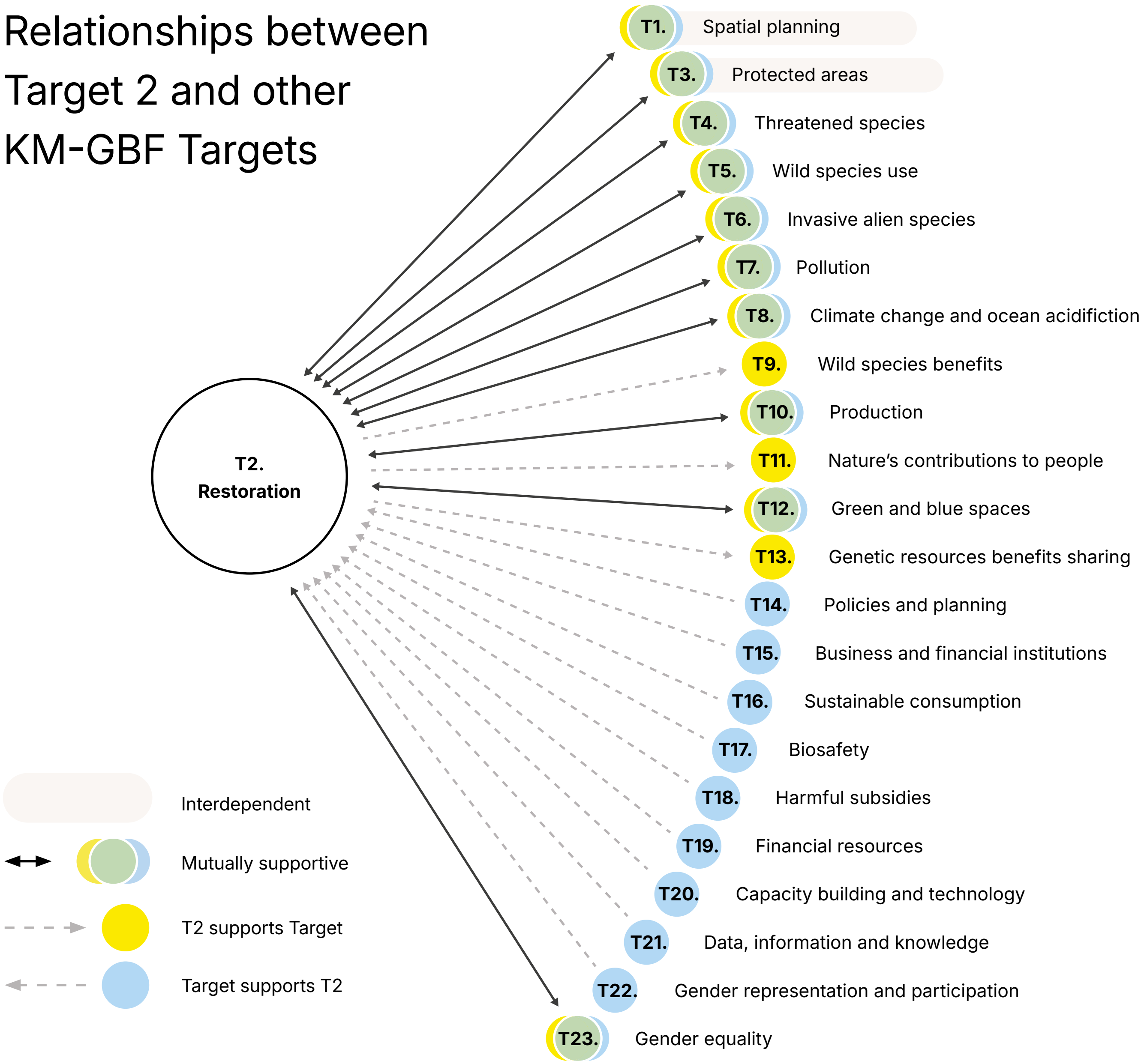
Target 2 and two other area-based targets (Targets 1 for spatial planning and Target 3 for protected and conserved areas, OECMs and Indigenous Territories) emphasize landscape, watershed and seascape approaches and principles, guiding actions to prevent biodiversity loss and to protect, restore and manage natural and production ecosystems. Effective ecosystem restoration will be achieved through activities contributing to all three targets. Indeed, the landscape, watershed or seascape context is a key consideration both for the assessment of degradation and for restoration planning (Gann *et al*., 2019; Nelson *et al*., 2024). Landscape, watershed and seascape approaches, such as Forest and Landscape Restoration, Multi-habitat Seascape Restoration, Aquatic Ecosystem Restoration, Source-to-sea and Landscape Approach also recognize the multifunctional mix of ecosystems and land use with multiple stakeholders and diverse human-nature interactions.

Importantly, the interdependence of the needs of nature and people must be elevated. Target 2 should be seen as strongly connected to Target 11, which aims to restore, maintain and enhance nature's contributions to people, and is essential to achieving sustainable livelihoods and poverty eradication (CBD/SBSTTA/26/INF/15). The complementarity of the headline indicators for Target 2 (area under restoration) and Target 11 (services provided by ecosystems) are particularly important to consider when planning, implementing and monitoring restoration. While not all restoration projects or programmes will yield improvements in all key outcome areas, effective restoration delivered through Target 2 can contribute to a diversity of goals and commitments simultaneously, and yield many benefits for both people and nature. These benefits flow to both natural ecosystems and production landscapes, underpinning the health and prosperity of each country individually and all countries collectively. Finally, national frameworks can and should guide planning and action at the subnational or local level where restoration functionally takes place, moving from commitment to implementation of effective ecosystem restoration.

Figure 5.3 Relationships between Target 2 and other KM-GBF targets.
Source: Authors' own elaboration.


Relationships between Target 2 and other KM-GBF Targets
T2. Restoration
T1. Spatial planning
T3. Protected areas
T4. Threatened species
T5. Wild species use
T6. Invasive alien species
T7. Pollution
T8. Climate change and ocean acidifiction
T9. Wild species benefits
T10. Production
T11. Nature’s contributions to people
T12. Green and blue spaces
T13. Genetic resources benefits sharing
T14. Policies and planning
T15. Business and financial institutions
T16. Sustainable consumption
T17. Biosafety
T18. Harmful subsidies
T19. Financial resources
T20. Capacity building and technology
T21. Data, information and knowledge
T22. Gender representation and participation
T23. Gender equality
Interdependent
Mutually supportive
T2 supports Target
Target supports T2

T1. Spatial planning

T1 ensures that spatial planning and management processes consider restoration. T1 helps prioritise ecosystems and restoration approaches and activities for T2, building a stronger pathway towards effective restoration, and can reduce future degradation resulting in more net gain from restoration activities. Considering priorities for T2 and T3 together contributes better outcomes for T1.

T3. Protected Areas

A. Protected and conserved areas provide reference sites for restoration and help to maintain or improve their ecological integrity. Legally recognized protected and conserved areas, including the lands of Indigenous Peoples and other collective customary rights holders, improve the institutional enabling environment for long-term restoration. **B.** T2 can increase the value of protected and conserved areas to stakeholders by increasing the delivery of ecosystem services (e.g. clean water, soil conservation, coastal protection). **C.** T2 can strengthen the value of protected and conserved areas by increasing spatial ecological connectivity, and through prioritising the restoration of ecosystems that are poorly represented. **D.** T3 increases the spatial extent of effectively conserved and managed protected areas. Many new protected and conserved areas will require restoration. **E.** T3 and T2 both focus on enhancing and managing biodiversity and ecosystem functions. T2 can increase the value of protected and conserved areas through the restoration of depleted biodiversity, and of ecosystem integrity and function. Well-managed protected and conserved areas enhance T2 by increasing capacity for natural regeneration, both within and near protected areas. **F.** T3 and T2 share many common methods (e.g., control of invasive species) and tools (e.g., IUCN Red List of Ecosystems to prioritise areas for restoration). (See also the 30×30 Solutions website).

T4. Threatened species

T2 directly contributes to halting species extinction as well as conserving, protecting and enhancing genetic diversity when appropriate species choices are made and appropriate genetic material used. T4 can contribute to restoration project objectives, both through the increase in spatial extent and integrity of threatened species habitats, and through the recovery of threatened species populations as components of ecosystems under restoration. (See also the Reverse the Red website).

T5. Wild species use

T2 techniques can support many activities needed to avoid overexploitation and recover sustainable wild-harvest habitats and populations essential for T5. Similar to T4, protection and sustainable use of wild species can contribute to restoration project objectives that aim to increase the integrity and resilience of ecosystems that contain commercially and culturally important wild species.

T6. Invasive alien species

Preventing and reducing the introduction of invasive species supports T2. The control or eradication of invasive species and the enhancement of ecosystem integrity and resistance to invasion through restoration programmes supports T6.

T7. Pollution

Reducing pollution decreases degradation drivers and improves T2 outcomes in highly degraded ecosystems. Remediating contaminants through restoration directly supports T7. Best practices for restoration that reduce use of pesticides and hazardous chemicals directly supports T7.

T8. Climate change and ocean acidifiction

T2 contributes to T8 through the restoration of ecosystems that take climate change into account during the planning stage, which can increase resilience through mitigation, adaptation, and disaster risk reduction. T8 contributes to T2 through its contribution to nature-based solutions to climate change mitigation and adaptation. Restoration of vegetation for e.g., carbon sequestration, should consider a biodiversity approach including provision of habitats and food for various trophic levels.

T9. Wild species benefit

T2 increases spatial extent and integrity of habitats for wild species, supporting both biodiversity and human livelihoods.

T10. Production

Innovative T2 techniques can support T10. The restoration of degraded landscapes and seascapes contributes to both targets. The application of biodiversity-friendly practices in agriculture, fisheries and forestry that help to rehabilitate degraded production systems is a contribution to T2. Sustainable management and sustainable intensification of production landscapes and seascapes also prevents the expansion of unsustainable production into natural ecosystems.

T11. Nature’s contributions to people

T2 enhances ecosystem functions and services, strongly supporting T11. T11 is closely connected with T2, focusing on the socio-economic outcomes of ecosystem restoration including poverty reduction through people-centred restoration that supports the needs of women, Indigenous Peoples, local communities and the poor and vulnerable.

T12. Green and blue spaces

Restoration can contribute to the creation of urban and peri-urban blue and green spaces for T12. The restoration of blue and green spaces in urban and peri-urban areas is a contribution to T2.

T13. Genetic resources benefits sharing

Effective restoration increases abundance of genetic resources and the potential for associated fair and equitable benefits sharing, prospective sequencing information, and knowledge exchange needed for T13.

T14. Policies and planning

Integration of the multiple values of biodiversity into decision-making, policies and practices across different sectors and governance levels supports T2.

T15. Business and financial institutions

Business sector actions to reduce negative impacts on biodiversity and increase positive impacts supports T2. Incentivising businesses to disclose their impact on ecosystems supported by enhanced transparency and traceability along their supply chains will help to reduce pressure on ecosystems and avoid future degradation.

T16. Sustainable consumption

Reducing the global footprint of consumption reduces the impact of the drivers of ecosystem degradation and supports T2.

T17. Biosafety

Increased biosafety decreases the spread of harmful modified organisms, pests, and diseases that would prevent effective restoration in T2.

T18. Harmful subsidies

The reduction or elimination of harmful subsidies is key to reducing or eliminating drivers of degradation imperative to achieving effective restoration in T2.

T19. Financial resources

Increasing biodiversity related financial resources, leveraging private finance, stimulating innovative schemes that have environmental and social safeguards, optimising co-benefits, and enhancing collective actions to implement NBSAPs supports T2.

T20. Capacity building and technology

Strengthening capacity-building and development, access to and transfer of technology, and promoting development of and access to innovation and technical and scientific cooperation supports T2.

T21. Data, information and knowledge

Ensuring that the best available data, information and knowledge are accessible to decision makers, practitioners and the public supports T2.

T22. Gender representation and participation

Ensuring full, equitable, inclusive, effective and gender-responsive representation and participation by all stakeholders, especially Indigenous Peoples and communities at large, supports T2.

T23. Gender equality

Gender responsive approaches to restoration creates opportunities for women and girls, thus supporting T23. Creating equal opportunity and capacity for women and girls supports effective restoration in T2.

5.3 Who to involve

Multiple stakeholder and rights and knowledge holder groups are optimally involved through broad, active participation in developing and setting national targets and in the preparation of NBSAPs. When working with Indigenous Peoples, it is pivotal to respect their right to free, prior and informed consent (Box 5.2). Because of the large number of potential participants, subnational and local stakeholders and rights and knowledge holders may be represented by groups at the national level, where they can provide key inputs into the process. The broader the stakeholder and rightsholder participation and buy-in, the more likely restoration will be sustainably supported.

> One of the key functions of a broad, active consultation is to ensure the safeguarding of both nature and people, respecting their rights and knowledge and their active participation and leadership in restoration initiatives.

As described in Section C of the KM-GBF (Annex C) a whole-of-government and whole-of-society approach is required (see Case Study 5.1), including ensuring considerations of human rights and the rights of Indigenous Peoples, gender equality and empowerment of women and girls, and the inclusion of youth and other underrepresented groups. In addition, while NBSAP planning takes place at the national level, plans ultimately must be operationalized to reflect the conditions, challenges and opportunities at the local level and prioritize the inclusion of Indigenous Peoples by recognizing their unique connection to the land and their role in biodiversity conservation and restoration.

Because of the potential broad geographic and social effects of restoration, key stakeholder and rights and knowledge holder groups may include:

- government policymakers, planners, and technical staff in national, subnational, and local agriculture, fisheries, forestry, land management, and wildlife departments; ministries of energy, environment, health, infrastructure, mining, production, natural resources, water, oceans, culture, planning, and finance; and CBD country focal points;
- representatives from Indigenous Peoples, including sovereign indigenous nations, tribes, or communities within country boundaries;
- national and subnational level Indigenous Peoples' federations (see CBD/WG8J/REC/12/2[3]), local community federations, associations, community-based organizations, human rights specialists, and other civil society groups;
- farmers, fishers, and resource users associations; national, subnational, and local government representatives or groups, including those that own, govern, and manage territories; landscape, coastal zone, marine, and river basin planners; and watershed councils or water boards where they exist;
- planning and technical staff in NGOs and cooperation agencies covering biodiversity conservation; land, water, natural resource ownership, use rights, and livelihoods; community engagement and awareness raising; and support to Indigenous Peoples and local communities;
- restoration alliances and UN Restoration Decade flagships;

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[3] Recommendation adopted by the Ad Hoc Open-ended Inter-sessional Working Group on Article 8(j) and Related Provisions of the Convention on Biological Diversity, which will be sent to COP 16 for its consideration.

- experts from professional societies and academic institutions and representatives from Indigenous and local knowledge holders that specialize in conservation biology, ecological connectivity, ecological restoration, forest and landscape restoration, water management, wildlife, fisheries, regenerative agriculture, rewilding, and related disciplines;
- private sector and industry entities holding or managing land or water where degradation could be reduced, or that could be placed under effective restoration; representatives from the agriculture, energy, forestry, aquaculture, fisheries, mining, and transport sectors;
- the public and private financial sector, including representatives of multinational banks, development banks, private sector finance mechanisms, insurance, resource mobilization, and other related entities;
- the legal sector, including representatives of organizations that can assist in improving legal enabling factors for restoration;
- representatives of neighbouring countries, in cases where transboundary cooperation is relevant, such as in relationship to migratory species, fisheries, or other shared ecosystem components; and
- UN and international organization staff and staff of other relevant commissions and multilateral environmental agencies.

BOX 5.2 Indigenous Peoples as game changers in biodiversity conservation

The KM-GBF recognizes the role of Indigenous Peoples as custodians of biodiversity and key partners in the protection of the environment. Indigenous Peoples possess individual, collective and customary rights, including rights over their lands, territories and natural resources. Their knowledge and governance systems are integral to effective biodiversity conservation and restoration. Additionally, their connection with the environment, based on relations of mutual respect and dignity, form part of their cosmogonic and spiritual values.

Section C of the KM-GBF encourages Parties to ensure the full and effective participation of Indigenous Peoples in decision-making, and acknowledges the contributions of Indigenous Peoples to all targets.

Despite covering less than a quarter of the world's land surface, Indigenous Peoples' territories contain much of the world's remaining biodiversity and intact landscapes (Garnett *et al.*, 2018; Fa *et al.*, 2020). Furthermore, over one-third of the world's irrecoverable carbon is found within Indigenous Peoples' territories (Noon *et al.*, 2021). Research shows that by being holistic, Indigenous Peoples' food systems are key to preserving and restoring the biodiversity of the unique ecosystems they inhabit and contain pivotal knowledge to restore degraded ecosystems, which is crucial for achieving global environmental and climate change goals (FAO, 2021). Indigenous Peoples have maintained the ecosystemic balance, connectivity and integrity, generating their food without endangering the environment. Their knowledge is unique and fundamental to achieve the environmental and climate change goals and targets.

In the case of the KM-GBF Target 2, any restoration activity must recognize the benefits of involving Indigenous Peoples, including through Indigenous-led initiatives and rights-based approaches. Inclusive approaches must identify barriers to Indigenous Peoples' participation, including land tenure issues. Engagement with Indigenous Peoples must include obtaining their free, prior and informed consent; informing relevant customary authorities; and respecting their customary and collective rights, territorial management practices and land tenure systems. Indigenous Peoples are holders of their knowledge and decide what they want to share (UNDRIP, 2007).

One example of Indigenous-led and rights-based approaches to support the implementation of Target

2 is the **Indigenous Peoples' biocentric restoration Initiative.** It was developed by Indigenous Peoples' leaders in collaboration with FAO Indigenous Peoples, and defined as an alternative way of restoring degraded ecosystems. It places Indigenous Peoples' cosmogony, knowledge, culture, beliefs and territorial management practices at the centre, with the main aim of re-establishing the forgotten memory of the territory.

From a biocentric perspective, Indigenous Peoples place their cosmogony and belief systems, the environment, and biodiversity at the centre of their restoration practices, in both natural and semi-natural ecosystems. They respect nature independent of the uses that humans derive from it. This follows a biocentric logic, meaning that rivers, lakes and forests have rights to existence that are not necessarily linked to their utilitarian value. Nature is often considered sacred and as a living entity that is inseparable from society. The approach recognizes the collective and customary rights of Indigenous Peoples and bases restoration on their collective work. It also involves communities and households in conservation and restoration activities, while considering all living beings in the ecosystem, as well as their relations and interactions with both biotic and abiotic elements.

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Case study 5.1 Towards effective ecosystem restoration in Peru :

a whole of government approach through multi-stakeholder process

Peru is one of the world’s most megadiverse countries, supporting extraordinary biodiversity across its many ecosystems, including a wealth of species of flora and fauna as well as remarkable genetic diversity. This natural capital supports sustainability within and beyond Peru including the well-being of its people, who depend on ecosystem services for the provision of food, water and other essential resources. Peru hosts the second highest share of the Amazon, placing forest conservation at the centre of the biodiversity and climate change agenda. The escalating degradation of ecosystems and loss of biodiversity, worsened by climate change, has heightened the urgency for ecosystem restoration in Peru. This destructive cycle begins with the conversion of pristine ecosystems into unsustainable farmland leading to habitat loss, fragmentation and the impoverishment of ecosystem functions.

Restoring the estimated 19.3 million hectares of degraded land (MINAM, 2022) is therefore crucial for recovering ecosystem functions across the agricultural-forest continuum. Successful restoration will yield significant biodiversity and conservation benefits by reducing pressure on natural habitats and bolstering vital ecosystem services. Achieving this ambitious goal demands a "whole-of-government" approach. Despite progress in developing restoration policies and monitoring tools, such as the National Strategy for Restoration of Ecosystems and Degraded Forest Lands (ProREST) and the National Restoration Gap, implementation on the ground remains hindered by fragmented responsibilities across environmental, forestry, and agricultural sectors, complicating collaboration at the subnational level. To address this challenge the Peruvian government needs to expand its restoration ambitions and leverage synergies across these sectors, and build strong political will and collaboration across relevant ministries to restore both forested and agricultural lands.

Cross sectorial initiatives such as the platform *“Grupo de Trabajo Multiactor de Restauración”*, emerge as an effective transformative practice to convene and foster collaboration and alignment among sectors. By convening and fostering collaboration, these platforms establish the foundation for an integrated governance framework. This should be based on a common vision that reflects consensus on national priorities, considering the diversity of ecosystems, sectors and actors involved. This approach can effectively support the updating of Peru’s NBSAP and the National Development Plan in an innovative way that could also be extended and applied to other targets.

Note: This case study was prepared by Valentina Robiglio, V.Robiglio@cifor-icraf.org , Rocio Vasquez, R.Vasquez@cifor-icraf.org

6. HOW TO IMPLEMENT RESTORATION COMMITMENTS FOR TARGET 2

This section outlines the essential components to operationalizing restoration to meet national commitments and KM-GBF Target 2. The following major groups of activities and steps, modified from the STAPER and UN Restoration Decade Principles and SOPs, may be implemented as appropriate. The groups of activities and steps are also supported by briefs from restoration policy, science and practice, as well as additional resources, guidelines and tools. The major groups are: assessment of opportunities for ecosystem restoration (6.1); improving the institutional enabling environment for ecosystem restoration (6.2); planning, implementation, and ongoing management of ecosystem restoration activities (6.3); and, monitoring, evaluation, feedback and sharing results (6.4). This section includes case studies and lessons learned from multi-actor and multi-scale initiatives, including discussions of trade-offs and challenges in planning, implementing and monitoring restoration. References are provided as examples only.

6.1 Assessment of opportunities for ecosystem restoration

The assessment phase of restoration planning offers an opportunity to consider and prioritize degraded ecosystems for restoration action; engage Indigenous Peoples, local communities, and other relevant stakeholders and rights and knowledge holders; consider gender balance; and assess the potential of restoration as a tool for addressing a wide variety of ecological and social issues. Effective approaches to assessment and planning can help prevent challenges at later stages of implementation or ongoing management, while simultaneously enhancing restoration opportunities. The following steps may be taken as appropriate.

1. Assess the extent, drivers, degree and location of degraded ecosystems, considering the 30 percent global target for terrestrial, inland water, and coastal and marine ecosystems (Section 3.1).

2. Determine national baselines by area at the beginning of the KM-GBF period for major ecosystem types prioritized for restoration (Section 3.2).

3. Determine national targets by area for major ecosystem types prioritized for restoration, including production ecosystems, and identify opportunities to increase ecological connectivity.

4. Use regional, national and subnational platforms, involve Indigenous Peoples, local communities, and other relevant stakeholders and rights and knowledge holders such as local authorities, in restoration assessment, planning and prioritization processes.

5. Identify options to reduce or eliminate the drivers of the loss of biodiversity and the degradation of ecosystems at various scales.

6. Identify and prioritize geographical areas where restoration would contribute most significantly to achieving national level targets by 1) minimizing the trade-offs and maximizing synergies and complementarities between restoration commitments under various international, regional and domestic initiatives and with other targets of the GBF and 2) prioritizing locations with high biodiversity value (e.g. protected areas, key biodiversity areas, important bird and biodiversity areas, Alliance for Zero Extinction sites), socio-economic value (e.g. sites contributing to poverty reduction, delivery of ecosystem services), cultural value (e.g. culturally significant sites, Indigenous Peoples' territories), and recovery potential that optimally contribute to increased ecological connectivity.

7. Review, improve or establish terrestrial, inland water, and coastal and marine spatial planning processes and zoning activities aligned with Target 1. Site-based actions should be taken in the context of integrated landscape and seascape management practices.

Considerations in the context of restoration policy, science and practice	See also
Avoid unintentional damage to natural ecosystems The use of proactive regulations, legal protections and restoration guidance (e.g. CBD, 2016; Brancalion and Chazdon, 2017; Gann *et al.*, 2019; Di Sacco *et al.*, 2021) are needed to prevent unintended ecosystem destruction, such as the afforestation of biodiverse grasslands in terrestrial or coastal ecosystems (Veldman *et al.*, 2015). While global maps and tools are useful at coarse scale, assessments of restoration opportunities should always be scaled down appropriately to national, subnational or local levels, drawing on expert knowledge.	Annex E: Global Resources Annex E: A.1
Assess common stakeholder expectations for long-term ecosystem restoration initiatives Establishing shared goals and expectations among stakeholders may ensure long-term ecosystem restoration outcomes. A unified, cost-effective vision strengthens adaptive approaches, diversity and participation in ecosystem restoration strategies (Mansourian, 2021; Frietsch *et al.*, 2023; Mansourian *et al.*, 2024).	Annex E: Global Resources Annex E: A.2 Annex E: A.3
Account for all potential benefits of restoration Consider multiple restoration benefits to support complementary commitments, targets and goals by quantifying potential benefits including biodiversity, ecosystem services, and social and economic impacts, and encouraging policy support and community involvement (Alexander *et al.*, 2016; Nelson *et al.*, 2024). Document the importance of biodiversity to nature's contributions to people to help inform the management of biodiversity in social-ecological systems (Bianco *et al.*, 2024).	Section 2. Annex E: Global Resources Annex E: A.2 Annex E: A.4 Annex E: A.5

Considerations in the context of restoration policy, science and practice	See also
Identify optimal restoration locations and types on the landscape Identifying optimal restoration sites and types helps improve biodiversity recovery, the enhancement of ecosystem functions and services, and ecological connectivity. Resources to guide strategic planning include: ecological connectivity guidance (IUCN-WCPA, 2023), landscape-scale prioritization models (Silva *et al.*, 2023), Multi-Criteria Decision Analysis (Wang *et al.*, 2023), analyses of trade-offs between native and plantation forests (Hua *et al.*, 2022), applying the Red List of Ecosystems to ecosystem restoration (Valderrábano *et al.*, 2021), marine connectivity 'Rules of Thumb' (Lausche *et al.*, 2021), global prioritization models (Strassburg *et al.*, 2020), Restoration Opportunities Optimization Tool (ROOT) (Beatty *et al.*, 2018), strategies for restoration in agricultural landscapes (Rey Benayas and Bullock, 2012), and Restoration Opportunities Assessment Methodology (ROAM).	Annex E: A.1 Annex E: A.2

6.2 Improving the institutional enabling environment for ecosystem restoration

Improving the enabling institutional framework for ecosystem restoration is a key step leading to successful implementation and ongoing management.

This includes providing a clear and stable legal basis for restoration; legal, economic and social incentives and appropriate planning mechanisms; and fostering cross-sectoral collaboration to promote restoration and minimize ecosystem degradation while reducing poverty and improving livelihoods (see Case Study 6.1). In addition, policies should include biodiversity as a required objective starting in the restoration design phase (e.g. in rehabilitation projects), rather than assuming biodiversity will benefit from ecosystem restoration projects. The improvement in enabling conditions, including policies and measures that promote long-term progress and foster replication and scaling up, is also included in Principle 10 of the UN Restoration Decade Principles. The following steps may be taken as appropriate.

1. Review, improve or establish legal, policy, governance and financial frameworks for the restoration of ecosystems, including approaches that actively decouple restoration from new degradation. Frameworks should also make explicit linkages to biodiversity protection and enhancement, sustainable development plans and poverty reduction strategies.

2. Review, improve or establish targets, policies and strategies for ecosystem restoration, including a national system for ecosystem restoration monitoring (see Case Study 6.2).
3. Identify capacity gaps and capacity building needs for all phases of restoration, both national and subnational, and include them in NBSAP capacity building plans.
4. Develop plans for resource mobilization. Create a framework for mobilizing resources to support ecosystem restoration, including defining specific kinds of interventions that could be supported by different finance actors.
5. Review, improve or establish a legal and policy framework to secure land tenure; recognize the rights of Indigenous Peoples, local communities, and other relevant stakeholders and rights and knowledge holders to participate in all stages of the restoration process; and ensure gender balance (linked to Targets 21 and 22).
6. Incorporate safeguard measures for Indigenous Peoples and other groups. Ensure that restoration activities do not diminish or violate the rights of Indigenous Peoples or other groups or contribute to their displacement.
7. Consider the need for safeguard measures to reduce risks of displacing habitat loss and degradation as well as other risks to biodiversity.
8. Develop national accounting processes that take into account the monetary and non-monetary (e.g. cultural) values of biodiversity, natural and semi-natural ecosystems, and the functions and services they deliver.
9. Promote economic and financial incentives that support restoration and eliminatet, phase out or reform incentives harmful to biodiversity.
10. Promote and support capacity building, training and technology transfer, and formal and informal education systems, including university and technical institutions, for all stages of ecosystem restoration to improve the effectiveness of restoration programmes and generate and share knowledge.
11. Encourage participation of universities and research institutions in restoration projects, focusing on the generation of scientific evidence on restoration methods and ecosystem recovery, research gaps and monitoring.

Case study 6.1 Maximizing agroforestry's productive and restorative potential

through policy support in India

Agroforestry, broadly defined as the intentional integration of trees with agricultural crops and/or animals, is a key strategy for productive ecosystem and biodiversity conservation. Successful uptake of agroforestry practices, however, requires enabling environments that guarantee rights to trees and land, provide farmers with investments, and facilitate marketing agroforestry products.

India has a long history of agroforestry as a traditional land management system and has been heavily involved in agroforestry research for at least 50 years. Recognizing the structural issues to scaling-up and maximizing the benefits of agroforestry in the country, the Government of India developed an intersectoral National Agroforestry Policy in 2014. The policy's goals are to increase productivity through agroforestry and to meet the increasing demand for timber, food and non-timber forest products, while improving the livelihoods of rural farming populations, ensuring food security and protecting ecosystems.

As one of the aims under the National Agroforestry Policy, India has recently launched the Greening and Restoration of Wasteland with Agroforestry (GROW) initiative. Today, agroforestry is being practised on more than 28.43 million ha in India, while the area under 'wastelands' is 55.76 million ha. In this context, wastelands are defined as degraded lands that can be brought under vegetative cover with reasonable effort and which are currently underutilized. The initiative recognizes the potential to convert degraded areas into productive and sustainable use through agroforestry. This is also a key strategy to meet its national goals to restore 26 million hectares of degraded land by 2030 and to increase national tree cover by 33 percent. As part of GROW, NITI Aayog, a public policy think tank of the Government of India, has developed an open-access GIS platform to assess the suitability of agroforestry in different categories of 'wastelands' and have introduced an Agroforestry Suitability Index for national-level prioritization. The GROW platform is intended to enhance government actors' implementation of agroforestry initiatives.

The existence of strong policy support for agroforestry in the country has triggered new investments, initiatives and technologies to assist the widespread adoption of agroforestry. India's National Agroforestry Policy also paved the way for other countries that have now developed their own agroforestry policies or strategies, including the Democratic People's Republic of Korea, The Gambia, Kenya, Nepal, Rwanda, South Africa and the United States of America; Nepal's (2019) national policy was founded on India's experience. Developing national policies and strategies is a key pathway for creating enabling environments and sustainably scaling up agroforestry in a way that meets national and international targets, including for ecosystem restoration.

Relevant links:
- *https://www.niti.gov.in/sites/default/files/2024-02/Grow%20Report%2020.02.2024.pdf*
- *https://www.frontiersin.org/journals/ecology-and-evolution/articles/10.3389/fevo.2023.1088796/full*
- *https://openknowledge.fao.org/items/01ea0192-f3e8-4c48-8928-6f000de4d968*

## Considerations in the context of restoration policy, science and practice	## See also
Ensure a policy environment that enables and incentivizes restoration An enabling policy environment, including through intersectoral policy coordination, is important for achieving restoration objectives and goals over the long term (FAO *et al.*, 2021). All relevant governance instruments (laws, regulations, policies, strategies and plans) should be mapped, adapted where appropriate, and integrated in the planning and implementation of projects, programmes and initiatives. The SDG process can inform enabling conditions for restoration. National policy integration, subnational initiatives, and education can affect and be affected by multiple goals, requiring an in-depth analysis of how one area may affect another to guide restoration and SDG implementation strategies (Hickman *et al.*, 2024).	Section 5 Annex C Annex E: B.1

Considerations in the context of restoration policy, science and practice	See also
Improve legal tools for restoration To date, the precise legal obligation of many restoration commitments has not been clear (Telesetsky *et al.*, 2017; Cliquet *et al.*, 2021; Mendes *et al.*, 2022; European Parliament and Council, 2024). However, the UN Restoration Decade and the KM-GBF provide opportunities for countries to advance the development of substantive and qualitative legal obligations for conducting restoration activities at the international, national, and subnational levels. Legal tools that can be used to upscale restoration include a regulatory mix of rules, principles and standards (Cliquet *et al.*, 2021). Legal frameworks at the international (e.g. the European Union Nature Restoration Law, see Box 6.1) and national levels can take advantage of existing and emerging law to facilitate ecosystem restoration (Akhtar-Khavari and Richardson, 2017). Where absent or poorly developed, the improvement of legal frameworks is essential to upscaling restoration.	Section 5.2; Annex E: B.1
Refer to principles and standards for guidance on enabling conditions The UN Restoration Decade Principles (Principle 10; FAO *et al.*, 2021) and the UN Restoration Decade SOPs (Nelson *et al.*, 2024) elaborate on a wide variety of enabling conditions for restoration, including governance, finance, coordination actions among institutions, sectors and stakeholders, capacity development, and knowledge co-generation and sharing. Significant guidance on respecting Indigenous Peoples as rights and knowledge holders are included in the UN Restoration Decade SOPs.	Annex E: Global Resources Annex E: B.1
Support standards-based restoration to deliver effective restoration Provide policy and legal support for the use of standards and certification in restoration, whether mandatory or voluntary, including practitioner and project certification as tools to lower risk, increase quality of outcomes, and improve capacity.	Section 3.4 Annex E: C.2
Finance and resource mobilisation Securing sufficient financial resources for all components of restoration is essential for successful outcomes (WRI, 2017; Nelson *et al.*, 2024). To do this, it is often critical to create partnerships and mobilize diverse sources of funding, including international (e.g. GEF, World Bank), regional (e.g. European Union), national, subnational and private (e.g., private philanthropy, corporate). Where feasible and appropriate, opportunities may be explored to mobilize finance through the sale of products and services that result from restoration activities (e.g. payments for ecosystem services, carbon credits, biodiversity credits) and facilitate access to markets for such products and services. Some NGOs offer tools or facilitate restoration financing.	Annex E: Global Resources Annex E: B.2
Enable continuous learning and capacity development opportunities Systematic capacity development and the need to mainstream restoration knowledge in education and natural resource management programmes at all levels, as outlined in the UN Decade Capacity, Knowledge and Learning Action Plan, enables all parts of society to engage in ecosystem restoration. An e-Learning and assessment tool based on this Resource Guide contributes to the capacity development on Target 2.	Section 7.1 Annex E: B.3

Considerations in the context of restoration policy, science and practice	See also
Create sustainable demand Increase demand for products from natural ecosystems under restoration, such as rewetted peatlands, to change from degradation based agriculture to sustainable agriculture (e.g., paludiculture). Support supply chain standards and certifications that encourage restorative and regenerative practices in production ecosystems (e.g., Union for Ethical Biotrade Regenerative Programme).	Annex E: B.2 Annex E: C.2
Safeguarding Ensure ecological and social safeguards for payments for ecosystem services, green bonds, and other benefits-sharing mechanisms.	Annex C Annex E: B.2
Compensatory restoration Ensure projects that destroy, damage or degrade natural ecosystems or native biodiversity, including projects that employ biodiversity offsets or credits, follow the Mitigation Hierarchy, where firstly environmental impacts are avoided; then impacts that cannot be avoided are minimized; when impacts occur rehabilitation or restoration takes place first on site; finally, any residual negative impacts are offset. The Mitigation Hierarchy should be implemented diligently and thoroughly. It is critical that its implementation should remain in the right order, avoiding offsetting before restoration, to prevent justifying further biodiversity loss (Jones *et al.*, 2022; Young *et al.*, 2022; Treweek *et al.*, 2023). The aim is at least no net loss and net gain or nature positive outcomes whenever possible, taking leakage into account.	Annex E: Global Resources
Support and incentivize restoration on private lands Financial incentives and other support systems, including robust legal frameworks, need to be explored and connected with market mechanisms to increase restoration participation on a large-scale. Government support can encourage private landowners to conserve and restore degraded landscapes, as shown by the European Networks for Private Land Conservation (ENPLC) and Partners for Fish and Wildlife Program. Restoration efforts may also benefit from regulation by law. For example, Brazil's Native Vegetation Protection Law or Forest Code requires rural property owners to participate in restoration and conservation (Lopes *et al.*, 2023).	Annex E: B.2
Invest in restoration infrastructure and the restoration economy National and subnational investments in restoration infrastructure (e.g., workforce training, creating incentives to acquire and share equipment and technology) can play a key role in scaling restoration.	Annex E: B.3
Develop globally standardized rapid assessment tools The development of globally standardized rapid assessment methods (e.g., score of gains and losses, or traffic light systems) to assist ecosystem restoration policy design would provide regulators and permitters with the appropriate knowledge and methods to prevent degradation and to identify appropriate locations and scale for restoration, especially for marine ecosystems. Existing datasets and methodologies can be leveraged to expand ecosystem databases on restoration efforts, supported by scientific and socioeconomic data necessary for prioritizing targets, planning, impact assessments, and monitoring outcomes.	Section 3.1 Annex E: A.1

Case study 6.2 Kenya Landscape Restoration Monitoring Technical Working Group and Restoration Monitoring Framework

The Kenya Forest and Landscape Restoration Monitoring Framework was developed to harmonize and coordinate reporting on landscape restoration efforts in the country and to bolster support to the government in reporting of its national, regional, and global restoration commitments. The monitoring framework was developed through a multistakeholder consultative process led by the members of the Restoration Monitoring Technical Working Group with feedback drawn through a series of meetings and workshops, at subnational level (county) engagement forums and a national validation event. The Technical Working Group on Monitoring was chaired by the Ministry of Environment, Climate Change and Forests, but engaged a number of other ministries and NGO actors in support of achieving its Terms of Reference. The resultant monitoring framework outlines 30 indicators and 45 sub-indicators for restoration monitoring considering both process or action indicators and impact indicators, exploring relevant tools and next steps to operationalize the framework. The framework has been endorsed and is included in Kenya's new National Ecosystem and Landscape Restoration Strategy 2024. The operationalization of the framework for use at local levels is underway, through county level engagement workshops, cross walking county forest and landscape restoration plans with the national framework to better understand information flow and indicator alignment for more coherent restoration monitoring.

Note: Kenya Landscape Restoration Monitoring Technical Working Group and Restoration Monitoring Framework are funded by UK PACT Project and led by ICRAF.

Relevant links:
Link to framework: https://apps.worldagroforestry.org/downloads/Publications/PDFS/2022039.pdf
Link to county level work: https://www.linkedin.com/posts/albert-mwangeka-536b0069_africanwildlifefoundation-fcdo-landscaperestoration-activity-7224055082596589568-CIVR?utm_source=share&utm_medium=member_desktop

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Box 6.1 The European Union Nature Restoration Law

The European Union Nature Restoration Law (NRL), adopted in June 2024, combines an overarching restoration objective for the long-term recovery of nature in the EU's land and sea areas, including inland waters, with binding restoration targets for specific habitats and species. These measures should cover at least 20 percent of the European Union's land and sea areas by 2030, and ultimately all ecosystems in need of restoration by 2050. While the 2030 target is lower than the GBF agreed restoration target, the longer-term objective for the NRL goes beyond Target 2. The NRL represents a paradigm shift in the global approach to ecological and ecosystem restoration by creating a proactive obligation to restore ecosystems, decoupled from continued degradation. While no single law can achieve all necessary enabling conditions for restoration, the NRL provides an important model for how Parties can create enabling conditions that either obligate or incentivize delivery of the restoration objectives outlined in Target 2.

6.3 Planning, implementation, and ongoing management of ecosystem restoration activities

Restoration projects and programmes should be planned and implemented based on the assessment process and considering the institutional enabling frameworks that exist or are in process of being revised or created at the national and subnational level. As identified in the UN Restoration Decade SOPs, there are three cross-cutting components to consider when planning, implementing, or conducting ongoing management of restoration projects: 1) broad engagement of stakeholders and rights holders in all aspects of the restoration process, in particular Indigenous Peoples; 2) regular and inclusive information sharing; and 3) adaptive management informed by sound monitoring and evaluation throughout all aspects of projects and programmes. In addition, the SOPs describe 13 subcomponents for planning and design, 11 for implementation, and 5 for ongoing management, each containing valuable guidance for best practice. For ecological restoration, the SER Standards contain extensive guidance on eight principles that underpin ecological restoration, SOPs for planning and implementing ecological restoration, and information on key topics including developing reference models, choosing restoration approaches, and selecting seeds and other propagules for restoration. As identified by the STAPER, capacity development for stakeholders, including legal and legislative support for the rights of women and Indigenous Peoples and local communities and other rights and knowledge holders, is often required. The following steps may be taken as appropriate.

1. Identify appropriate restoration types and approaches by drawing on multiple ways of knowing from a diversity of contributors, aligned with agreed project goals and objectives. Incorporate information from similar restoration projects (e.g., types of degradation, techniques to be deployed) and from the local area or country

that can inform restoration planning and implementation (see Case Study 6.3).

2. As appropriate, ensure that restoration activities support the ecological and economic sustainability of agriculture, forestry, fisheries and other production activities, as well as biodiversity enhancement, climate change mitigation and adaptation, disaster risk reduction, and enhancement of ecosystem functions and services including for urban areas.
3. Ensure that restoration benefits both people (e.g., improves livelihoods, reduces poverty) and nature (e.g., enhances biodiversity, ecosystem functions).
4. Develop ecosystem restoration plans and programmes with clear and measurable goals and objectives for expected ecological, economic and social outcomes.
5. Develop explicit implementation tasks, schedules and budgets, and identify the suitability and minimum qualifications of restoration team members.
6. Collect baseline data for restoration projects aligned with long-term restoration monitoring plans.
7. Implement the activities outlined in the ecosystem restoration plans in the most effective and coordinated manner possible, ensuring the appropriate use of materials, tools, and supplies, and worker safety and well-being.
8. Avoid collateral damage from restoration to natural ecosystems, and native plants, animals and other organisms.
9. Avoid the use of and minimize populations of invasive species to the extent practicable. Follow best practices for the translocation of plants, animals and other organisms.
10. Enhance and support the natural recovery potential of the restoration site, minimizing restoration activities to the extent possible. However, consider that completely unassisted natural regeneration alone may not optimize outcomes at most sites. Small investments in enrichment plantings of large-seeded species, for example, or reintroducing and supporting depleted wildlife populations may greatly increase the outcomes of restoration.
11. Plan for and operationalize an ongoing management plan to maximize outcomes, prevent deleterious impacts, and avoid regression into a degraded state.
12. Identify opportunities at the project site or in the broader landscape and seascape to replicate or scale up restoration activities and conduct additional restoration activities to take advantage of improved conditions at the site in the context of ongoing management and continuous improvement.
13. Optimize beneficial ecological connectivity to the extent practicable.

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Considerations in the context of restoration policy, science and practice	See also
Standards and guidelines Global, national, and ecosystem-specific standards guide ecosystem restoration planning, implementation, and monitoring, including specific guidelines for many ecosystem types and the improvement of practices through case studies and place-based knowledge and resources.	Section 3.4 Annex E: Global Resources Annex E: C.1 Annex E: C.2 Annex E: C.3
Multiple restoration types across habitats and land uses Ecological restoration and rehabilitation can be used side by side to restore natural ecosystems alongside production ecosystems, such as agroforestry systems in terrestrial ecosystems. Indigenous Peoples' food generation sustainable practices can combine elements of both. Similarly, restoration can occur across diverse ecosystems to support both biodiversity and livelihoods, such as cross-habitat facilitation restoration in marine areas (Vozzo *et al.*, 2023).	Section 2 Annex E: Global Resources Annex E: A.1 Annex E: C.1 Annex E. C.2 Annex E: C.3
Reference ecosystems and reference models Ecological restoration is informed by natural reference ecosystem targets, and planning and project design are guided by reference models, which integrate diverse data on natural biotic and abiotic conditions, historical conditions, and current and future predicted environmental change (e.g. climate change) in order to set goals and monitor progress (Gann *et al.*, 2019; Durbecq *et al.*, 2020; Toma *et al.*, 2023; Nelson *et al.*, 2024). Big data tools on species distributions (e.g. Global Biodiversity Information Facility) and ecological variables (e.g. Restor) can be very useful but must be paired with ground truthing and local knowledge.	Section 6.1 Annex E: Global Resources Annex E: A.1 Annex E: C.1
Baseline data collection The collection of pre-restoration baseline data for restoration projects is critical for impact assessment and future planning (Gann *et al.*, 2019; Nelson *et al.*, 2024).	Section 7.1 Annex E: Global Resources Annex E: C.1 Annex E: D.1
Species interactions Species interactions, such as pollination, seed dispersal, and predation, play a critical role in ecosystem restoration, ensuring biodiversity, ecological balance and resilience.	Annex E: C.1 Annex E: C.4
Genetic diversity of plants and other essential materials Ensuring genetic diversity and securing locally adapted native plant and animal materials are crucial for successful ecological restoration, enhancing ecosystem resilience, and achieving biodiversity conservation and sustainable development objectives. This is true for both native plants and animals for ecological restoration and agricultural livestock and crops.	Annex E: C.1 Annex E: C.4
Enhance ecological connectivity Enhance ecological connectivity through the dual approach of 'Restore to Connect, Connect to Restore'. Ecological corridors and networks are critical for maintaining and restoring biodiversity, ecosystem function and climate resilience (IUCN WCPA, 2023).	Annex E: Global Resources Annex E: A.1 Annex E: C.1

Considerations in the context of restoration policy, science and practice	See also
Plant and animal supply In most parts of the world, there are challenges and bottlenecks that must be overcome in the availability, production, and access to native seeds and other propagules required for restoration, including threatened species and agricultural crops. Indigenous Peoples, local communities, and small businesses can be engaged in the supply of seeds and other propagules to elevate local economic support and secure high biodiversity supply (Padovezi *et al.*, 2024). Indigenous Peoples’ knowledge in their role as custodians of genetic diversity must be respected, for example, in the case of many native seeds and species of flora and fauna.	Annex E: C.3
Workforce training Ecosystem restoration creates significant employment and contributes to sustainable economies. It is important to develop restoration-focused job training and supply chains that benefit local economies and strengthen the ecological restoration sector (BenDor *et al.*, 2023). Training and standards of practice for the workforce are critical for maximizing these benefits, promoting sustainable development and ecological recovery in countries (e.g. Brazil, Brancalion *et al.*, 2022) and on a global scale (Nelson *et al.*, 2017).	Annex E: B.3 Annex E: C.1
Project certification and verification Project certification and verification can help reduce risk and enhance restoration outcomes assessment, crucial for policy and stakeholder engagement. Incorporating traditional knowledge and community involvement improves success rates, urging a shift towards cost-effective, long-term ecological and socioeconomic goals.	Annex E: C.2

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Case study 6.3 Mexico's National Information System for Environmental Restoration (SNIRA)

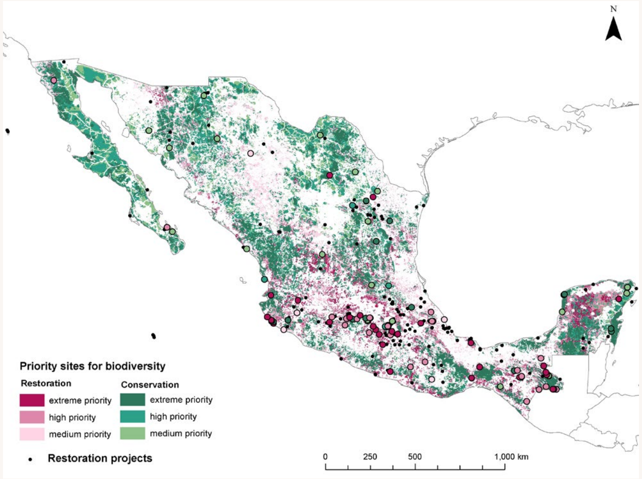
Mexico, a country known for its high biological and cultural diversity, faces significant challenges in restoring its diverse ecosystems, with more than two thirds of its continental territory classified as environmentally degraded. Efforts to address degradation and biodiversity loss have been implemented by government agencies, local communities, NGOs and academic institutions. However, challenges remain to address and recover biodiversity and ecosystem services. Furthermore, dispersed and fragmented data, limited access to systematized information, and a lack of coordination among stakeholders continue to hinder effective decisions and resource allocation.

To overcome these challenges, Mexico developed the National Information System for Environmental Restoration (SNIRA), a digital platform that consolidates information about restoration projects in the country. SNIRA integrates data from projects using diverse restoration approaches, such as ecological restoration, and rehabilitation, implemented by government agencies, academic institutions, civil society, indigenous groups, and local communities, thus, promoting transparency and collaboration, and allowing users to share best practices and lessons learned.

To date, information from over 600 projects across various ecosystems, including forests, rivers, islands, coastal, and marine areas, has been included. Of the 365 projects with spatial reference, more than half (54 percent) are located within priority areas for restoration, conservation, or bioclimatic corridors (see Figure 6.B1 and Figure B2). This information can help identify gaps, prioritize future efforts, and assess whether interventions are meeting their intended ecological and social objectives.

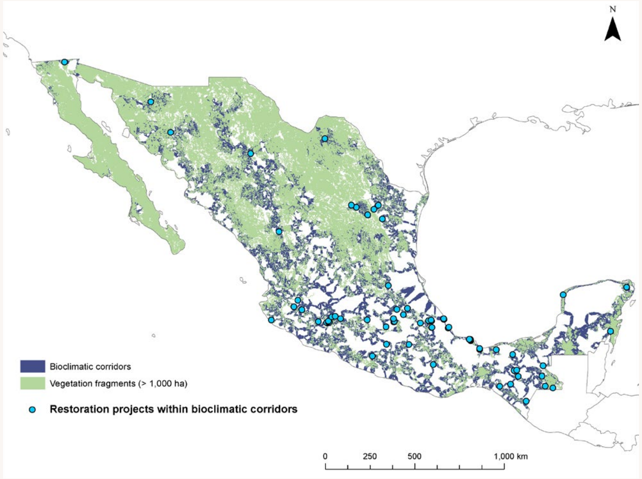
Providing access to detailed data, including socio-ecological benefits and barriers to restoration, enhances stakeholders' capacity to plan and implement restoration activities. Strengthening community involvement and stewardship is also crucial for sustaining long-term restoration efforts. Sharing restoration data through interoperable frameworks between organizations will be important for attracting further funding and bridging the gap between restoration knowledge and action to meet national and international restoration commitments.

Figure 6.B1: Priority restoration and conservation sites for biodiversity in Mexico


N
Priority sites for biodiversity
Restoration
extreme priority
high priority
medium priority
Conservation
extreme priority
high priority
medium priority
Restoration projects
0
250
500
1,000 km

Note: Refer to the disclaimer on page ii for the names and boundaries used in this map.

Figure 6.B2: Restoration sites that enhance connectivity in Mexico


N
Bioclimatic corridors
Vegetation fragments (> 1,000 ha)
Restoration projects within bioclimatic corridors
0
250
500
1,000 km

Note: Refer to the disclaimer on page ii for the names and boundaries used in this map.

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6.4 Monitoring, evaluation, feedback and sharing results

Restoration monitoring occurs at multiple scales, from the national and subnational scale to the programme and project scale. At the national level, reporting on Target 2 will focus on the headline indicator Area Under Restoration, and it is critical that a functioning national monitoring system is in place (see Section 7). At the project level, monitoring should begin during the earliest phases of project development to obtain baseline data that will enable ecosystem conditions and socioeconomic effects to be measured against agreed-upon goals and objectives. Effective monitoring benefits from establishing baselines, developing statistically robust protocols for data collection and assessment, identifying ecological, social and economic indicators, and setting clear and measurable objectives based on the selected indicators prior to the initiation of restoration activities. In addition, when appropriate, engaging Indigenous Peoples in monitoring and evaluation processes is crucial to incorporate their perspectives and traditional knowledge to ensure that practices are culturally appropriate and meet their needs and those of their lands and territories. The UN Restoration Decade SOPs describe 11 subcomponents for monitoring and evaluation, each containing valuable guidance for best practice. The following steps may be taken as appropriate.

1. Design an effective and focused monitoring plan to align collection of baseline data with long-term restoration monitoring and to enable adaptive management.

2. Determine the types of monitoring and evaluation that will be conducted: 1) the degree to which restoration activities are implemented as

planned (implementation monitoring), 2) the degree to which restoration goals and objectives are achieved (effectiveness monitoring), and 3) the ecological, cultural and socioeconomic impacts that result, whether positive or negative (impact monitoring). Include all three types of monitoring whenever and wherever feasible. (See Fig. 6.1)

3. Select indicators that align with national reporting to track biodiversity, ecosystem integrity, and human well-being that link to project goals and objectives at relevant timescales. Assess whether selected indicators will respond reliably within the necessary timeframe and whether incentivizing change in indicators could have any unintended negative outcomes. The best indicators are relatively easy to measure and are as stable as possible, yet sensitive within a reasonable time frame to the types of change expected with restoration. As planned and resourced, monitor and evaluate the implementation of ecosystem restoration projects, the effectiveness and the impacts of projects.

4. Periodically assess the effectiveness not just of the restoration activities, but also of the monitoring and evaluation effort itself.

5. Adjust plans, expectations, restoration activities and monitoring through adaptive management based on monitoring results and lessons learned, and promote sustainability beyond the end of primary project activities.

6. Share lessons learned from all phases of restoration with stakeholders to demonstrate the multiple benefits of ecosystem restoration, to improve transparency and participation, and to improve restoration practice by focusing resources on applying methods that work (see Case Study 6.4). Provide publicly available assessments where feasible and manage and archive data from monitoring in a secure format that provides long-term access and useability.

7. Utilize an interoperability framework, and align the data that are collected, so that information on local projects can be aggregated at the subnational and national level and shared with global datasets.

8. Through national and subnational platforms, provide tools, resources, education, and professional training, and develop opportunities for stakeholders and rights and knowledge holders to advise and participate in monitoring and evaluation activities, in order to learn and build knowledge, increase capacity for monitoring, foster long-term interest in restoration and improve project governance.

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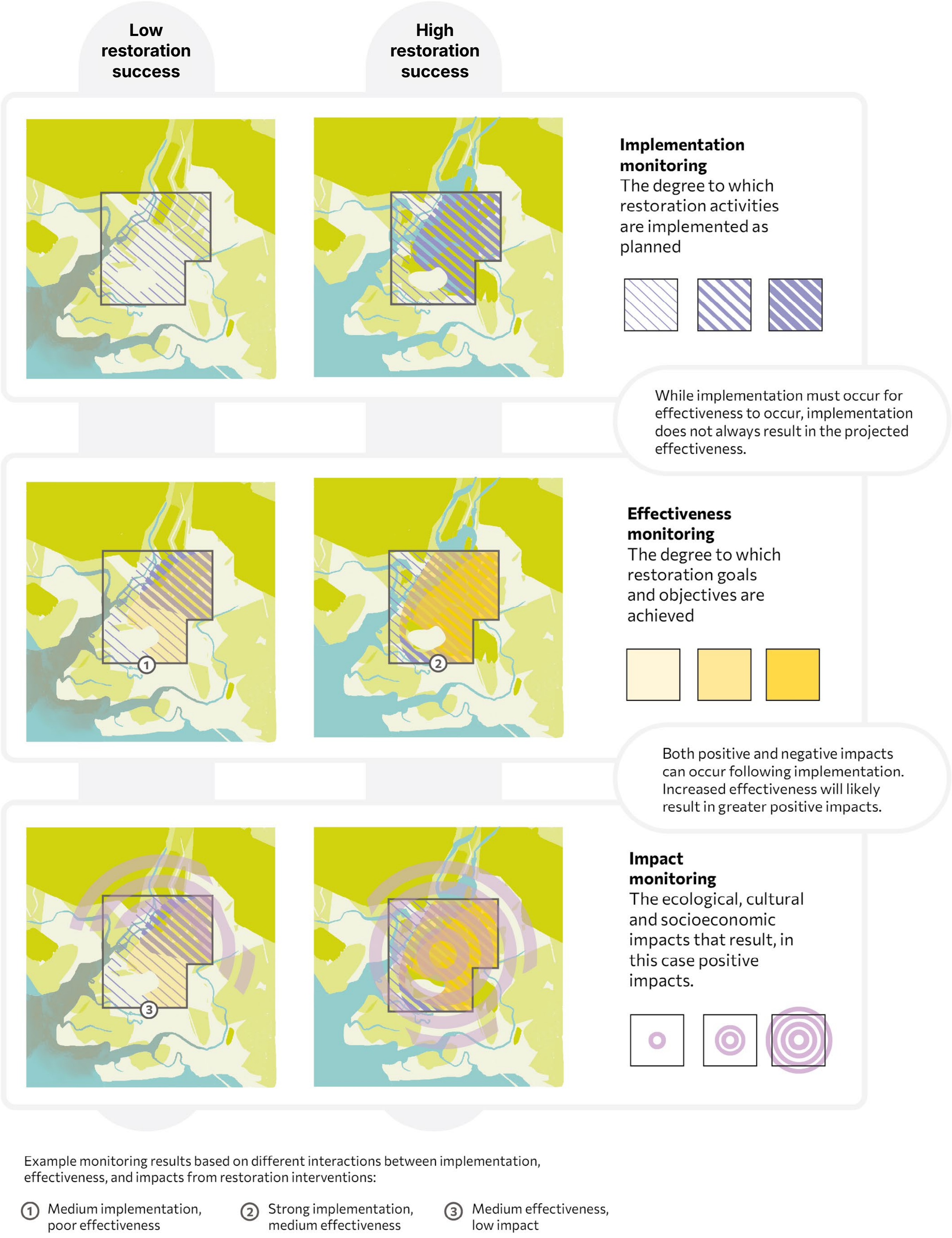
Figure 6.1 Visual representation of three major types of ecosystem restoration project monitoring.



Implementation monitoring The degree to which restoration activities are implemented as planned

While implementation must occur for effectiveness to occur, implementation does not always result in the projected effectiveness.

Effectiveness monitoring The degree to which restoration goals and objectives are achieved

Both positive and negative impacts can occur following implementation. Increased effectiveness will likely result in greater positive impacts.

Impact monitoring The ecological, cultural and socioeconomic impacts that result, in this case positive impacts.

Example monitoring results based on different interactions between implementation, effectiveness, and impacts from restoration interventions:

① Medium implementation, poor effectiveness

② Strong implementation, medium effectiveness

③ Medium effectiveness, low impact

Source: Authors' own elaboration.

Considerations in the context of restoration policy, science and practice	See also
Monitoring different major ecosystem types The three major ecosystem types identified in Target 2 (terrestrial, inland waters, and coastal and marine) each require different techniques and approaches to monitoring. In addition, monitoring programmes should choose indicators relevant to tracking progress for the agreed project goals and objectives and to the scale of the project location.	Section 3.5 Section 7.1 Annex E: D.1
Monitoring different restoration types and approaches Different types of restoration result in different types of outcomes, thus it is important to document the type of restoration when monitoring (i.e. ecological restoration versus rehabilitation). Also, it is helpful to record what restoration approaches are being used for the project (e.g. natural regeneration, assisted natural regeneration, reconstruction or intensively assisted natural regeneration), to contribute to meta-analyses of costs and outcomes. More projects are needed that compare multiple restoration approaches in the same system to determine which works better and is most cost effective.	Section 3.5 Section 7.1 Annex E: D.1 Annex E: D.4
Restoration timescales and recovery debt Recovery of ecosystems requires time (e.g. often decades or more). Regular monitoring, including over the long term, is needed to enable continuous improvement and to contribute to knowledge generation. The lag time between the initiation of restoration and the recovery of biodiversity and ecosystem functions has been described as the recovery debt (e.g. Rey Benayas *et al.*, 2009; Moreno-Mateos *et al.*, 2017).	Annex E: D.4
Interoperability It is important to have open data access wherever possible, strong data synthesis, and to share knowledge across platforms and at different scales to advance restoration science as well as to support evidence-based decision-making for ecosystem restoration practices (Ladouceur *et al.*, 2021; Gann *et al.*, 2022). Interoperability systems are critical for collecting information on small projects at the community and local level and aggregating them into national and global datasets, which can be used both for global restoration monitoring and meta-analyses. The Framework on Ecosystem Monitoring (the FERM) is designed to be interoperable, accepting data from frameworks such as Aurora and the Restoration Project Information Sharing Framework (ISF) (see Section 7.3). Collecting data from Indigenous Peoples must observe their free, prior and informed consent and be respectful of Indigenous Peoples' rights to knowledge and data sovereignty.	Section 7.4 Annex E: D.4 Annex E: D.6
Monitoring protocols Many monitoring methods have been developed for specific ecosystems, geographic areas, or to address particular questions. These may facilitate the monitoring of ecosystem restoration and the sharing of monitoring data. One of the central opportunities and challenges of contemporary restoration monitoring is how to appropriately utilize monitoring across vast scales and technologies, from remote sensing to traditional field survey methods, to emerging technologies and the use of big data.	Annex E: D.4
Role of Indigenous Peoples' knowledge Indigenous Peoples must be considered as holders of their knowledge. By including Indigenous researchers and highlighting the role of Indigenous Peoples' knowledge systems in addressing restoration monitoring, restoration monitoring can be improved.	Annex E: Global Resources Annex E: D.2

Considerations in the context of restoration policy, science and practice	See also
Choosing project monitoring indicators Restoration project monitoring indicators are chosen to track restoration implementation, effectiveness, and impact (Gann *et al.*, 2019; Nelson *et al.*, 2024). Optimally, the indicators chosen and the data collection methods used allow for interoperability and the sharing and aggregation of data. WRI and FAO have collaborated on the development of Aurora, a tool that “aims to help stakeholders develop a monitoring system tailored to their needs by identifying indicators and metrics to monitor progress toward their set goals.” Through a global consultation process, the ISF identified 17 headline indicators and 44 core and secondary indicators, including biophysical and socioeconomic variables, that are recommended for integration into restoration project monitoring programmes (Table 6.1). For ecological restoration projects, the SER 5-star System and Ecological Recovery Wheel are recommended for tracking the recovery of natural ecosystems (Figure 6.2). SER has also developed a Social Benefits Wheel that tracks socioeconomic and cultural change from restoration projects (Gann *et al.*, 2019). Table 6.2 aligns the ISF with the SER 5-star System to provide samples of indicators that can be used to track the change in ecological attributes from restoration projects.	Section 7.3 Annex E: Global Resources Annex E: D.4
Emerging and big data technologies There are a large number of emerging and big data technologies that can be deployed for restoration project monitoring, including eDNA, omics, stable isotopes, bioacoustics, remote sensing, and mobile apps. Emerging data analyses are also available, including novel statistical methods, artificial intelligence, and dense time series analysis. It is critical to match these technologies with the monitoring questions being asked, as well as technological and financial appropriateness.	Annex E: D.3 Annex E: D.4 Annex E: D.5
Statistical challenges and best practices Ecological systems are naturally highly variable, from time to time and from place to place. This variability leads to particular challenges in detecting change and therefore in designing efficient and effective monitoring protocols. Where sampling is expensive, having the resources to collect sufficient data to detect change is another major challenge. Best practices include setting the expectation that collecting monitoring data may be slow or difficult, working with an experienced ecological statistician when planning monitoring programmes, and incorporating information sources that are inexpensive or even free to collect over large areas over the long-term, e.g. remotely-sensed data, where possible.	Annex E: D.3
Participatory and innovative techniques for monitoring Efficient monitoring that incorporates community participation and stakeholder and rights and knowledge holder collaboration connects local and global restoration efforts. Techniques such as remote sensing by drones, setting up photo points, and utilizing easy to use survey applications can improve monitoring while lowering costs. Similarly, by involving the public and local communities and employing basic and reliable data collection techniques, participatory science can provide insight and supplement professionals in ecosystem restoration monitoring. Participatory science can be supported by a variety of mobile apps, such as the Cornell Lab Merlin app that identifies birds from calls and photos, and iNaturalist.	Annex E: D.2

Case study 6.4 Review of near-shore marine restoration

to improve wildlife abundance and diversity

Coral reefs, saltmarshes, mangroves, and seagrass habitats are in decline globally, affecting the animals that rely on them for survival.

A meta-analysis of marine restoration projects around the world aimed to identify if marine restoration projects assisted in the recovery of animal populations at inshore sites. 160 case studies of restoration projects at coral reefs, oyster reefs, saltmarshes, and seagrass habitats were reviewed. On average, biodiversity at restoration sites was 61 percent more abundant and 35 percent more diverse than in unrestored, degraded sites. These metrics were also compared to those at natural reference sites.

At restoration sites in coral reefs, animal communities were on average 165 percent more diverse and animal populations were 220 percent more abundant relative to degraded sites. The study found that there were some strong positive trends for populations, highlighting the benefits restoration can provide. This is especially valuable since a core goal of reef restoration is often to enhance fish biomass and ecosystem functionality, thus suggesting that such efforts can have a positive impact, even at small scales.

Five thousand data points from 160 peer review studies on coastal restoration projects were coded by descriptor, publication details, study locations, and restoration techniques, with a temporal distribution between 1990 and 2020. Saltmarshes, mangroves, seagrasses, macroalgae, coral and shellfish reefs were on average monitored over four years, with 34 percent of studies (54 out of 160) monitored at sites across multiple years.

Although outcomes were highly variable, marine restoration benefits included greater environmental awareness, enhanced education opportunities and increased employment in tourism and fisheries sectors. When applied appropriately, this case study can inform restoration planning and implementation, and provide evidence to support implementation of restoration projects.

Source: Sievers, M., Connolly, R. M., Finlayson, K. A., Kitchingman, M. E., Ostrowski, A., Pearson, R. M., Turschwell, M. P., Adame, M. F., Bugnot, A. B., Ditria, E., Hale, R., Silliman, B. R., Swearer, S. E., Valdez, S. R., & Brown, C. J. (2024). Enhanced but highly variable biodiversity outcomes from coastal restoration: A global synthesis. One Earth, 7(4), 623–634. https://doi.org/10.1016/j.oneear.2024.02.013

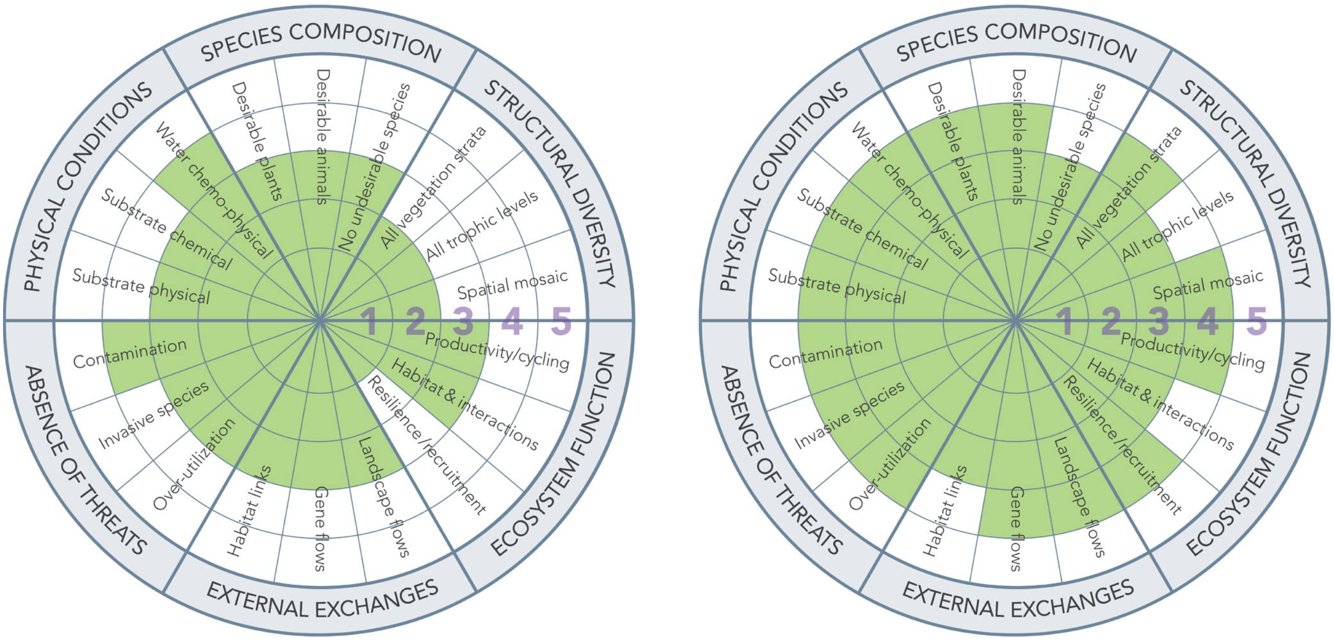
Table 6.1 Headline indicators identified by the Restoration Project Information Sharing Framework (ISF)

UN Decade Principles	ISF Headline Indicator
PRINCIPLE 1: Ecosystem restoration contributes to the UN SDGs and the goals of the Rio Conventions.	**Contributions to global commitments** Officially recognized contribution to national or regional commitments. **Extent of restoration** Extent of area undergoing restoration. Also aligns with Principle 4.
PRINCIPLE 2: Ecosystem restoration promotes inclusive and participatory governance, social fairness and equity from the start and throughout the process and outcomes.	**Stakeholders engaged** Types and diversity of stakeholders engaged. **Stakeholder engagement activities** Types of stakeholder engagement activities implemented. Also aligns with Principle 8.
PRINCIPLE 3: Ecosystem restoration includes a continuum of restorative activities.	**Categories of ecosystem restoration activities and approaches utilized** Major categories of restoration activities used in the restoration project or programme (i.e. reducing societal impacts, remediation, rehabilitation, ecological restoration, other). A sub-indicator tracking categories or approaches to rehabilitation and ecological restoration is recommended for those projects.
PRINCIPLE 4: Ecosystem restoration aims to achieve the highest level of recovery for biodiversity, ecosystem health and integrity, and human well-being.	**Biodiversity target status** Changes in biodiversity target status from pre-project baseline toward measurable project goals, accounting for leakage. **Ecosystem integrity** Change in ecosystem integrity status from pre-project baseline toward measurable project goals, accounting for leakage. This is a composite indicator, which includes Core and Secondary indicators. **Social-economic benefits** Change in delivery and sustainability of social-economic benefits from restoration from pre-project baseline toward measurable project goals, accounting for leakage. Also aligns with Principle 7. This is a composite indicator, which includes Core and Secondary indicators. **Carbon sequestration** Estimated change in sequestered aboveground carbon, soil organic carbon, and blue carbon equivalents from pre-project baseline toward measurable project goals, accounting for leakage. Also aligns with Principle 7.
PRINCIPLE 5: Ecosystem restoration addresses the direct and indirect causes of ecosystem degradation.	**Degradation causes** Trends in ecosystem degradation causes (or drivers) from pre-project baseline toward measurable project goals.

PRINCIPLE 6: Ecosystem restoration incorporates all types of knowledge and promotes their exchange and integration throughout the process.	**Knowledge and experience** Capacity and diversity of technical expertise and experience applied to restoration project. **Capacity building, skills, and knowledge development** Change in levels of capacity, skills, and knowledge from pre-project baseline toward measurable project goals, including those needed for planning, implementation, and monitoring. Also aligns with Principle 8.
PRINCIPLE 7: Ecosystem restoration is based on well-defined short-, medium- and long-term ecological, cultural and socio-economic objectives and goals.	**Goals and objectives** Specific, relevant, and measurable goals and objectives, and timelines are included in restoration plan and used to measure effectiveness (e.g., following SMART criteria).
PRINCIPLE 8: Ecosystem restoration is tailored to the local ecological, cultural and socio-economic contexts, while considering the larger landscape or seascape.	**Landscape/seascape scale planning** Landscape or seascape scale considerations that align with local project planning.
PRINCIPLE 9: Ecosystem restoration includes monitoring, evaluation and adaptive management throughout and beyond the lifetime of the project or programme.	**Monitoring effectiveness** Elements of effective monitoring included in the plan and implemented. **Adaptive management** Key lessons learned, adaptive management processes, and mid-course corrections taken to address unforeseen challenges and improve outcomes. Also aligns with Principle 6.
PRINCIPLE 10: Ecosystem restoration is enabled by policies and measures that promote its long-term progress, fostering replication and scaling-up.	**Enabling governance conditions** Changes in enabling governance policies, mechanisms, and institutional conditions at the national and subnational levels from pre-project baseline toward measurable project goals.

Source: Gann, G. D., Walder, B., Gladstone, J., Manirajah, S. M., & Roe, S. 2022. Restoration project information sharing framework. Society for Ecological Restoration and Climate Focus. https://cdn.ymaws.com/www.ser.org/resource/resmgr/publications/restoration-project-informat.pdf

Figure 6.2 An example of SER's Five-star System used to populate the Ecological Recovery Wheel at baseline (left) and 10 years under restoration.


SPECIES COMPOSITION
Desirable plants
Desirable animals
No undesirable species
STRUCTURAL DIVERSITY
All vegetation strata
All trophic levels
Spatial mosaic
ECOSYSTEM FUNCTION
Productivity/cycling
Habitat & interactions
Resilience/recruitment
EXTERNAL EXCHANGES
Landscape flows
Gene flows
Habitat links
ABSENCE OF THREATS
Over-utilization
Invasive species
Contamination
PHYSICAL CONDITIONS
Substrate physical
Substrate chemical
Water chemo-physical
1
2
3
4
5

Source: Gann, G. D., McDonald, T., Walder, B., Aronson, J., Nelson, C. R., Jonson, J., Hallett, J. G., Eisenberg, C., Guariguata, M. R., Liu, J., Hua, F., Echeverría, C., Gonzales, E., Shaw, N., Decleer, K., & Dixon, K. W. 2019. International principles and standards for the practice of ecological restoration. Second edition. Restoration Ecology 27(S1): S1–S46. https://doi.org/10.1111/rec.13035

Table 6.2 Information Sharing Framework (ISF) biophysical indicators mapped against the ecosystem sub-attributes used by the SER 5-star system and examples of evidence.

Biophysical Monitoring Indicators *(drawn from the ISF Indicators)*	General Indicators (used in multiple ecosystems) from the SER 5-star system **Sub attributes**	 **Examples of evidence**
Biodiversity Target Status (H)	Desirable plants, fungi, and lichens Desirable animals Rare and threatened species Provenance, genetic diversity, and genetic resilience	• Number of desirable indicator and keystone species • Number of protected or threatened species • Cover, density, or other measures of abundance • Demographic or genetic viability of rare or threatened species • Sex ratio • Translocated species provenance and diversity
Ecosystem integrity (H)	All vegetation strata All trophic levels Spatial mosaic Habitat and interactions	• Number, structure, growth form, and complexity of strata present • Appropriate microclimates present • Leaf area index • Species cover (by layer where applicable) • Diameter and height class distributions • Complexity, balance, and interactions of trophic levels • Soil or substrate microbiome • Spatial distribution of features • Patch history, size, and the ecotones between them • Habitat provision • Host plants for pollinators, frugivores, and nesting species • Occurrence of ecosystem engineers • Coarse debris and litter • Habitat quality indices • Constructed habitat features

Biophysical Monitoring Indicators

(drawn from the ISF Indicators)

General Indicators (used in multiple ecosystems) from the SER 5-star system

Sub attributes	**Examples of evidence**
Substrate - physical	• Similarity to the landforms in the surrounding landscape • Macro and micro variability measures • Water or wind erosion (e.g., erosion rills, gullies, piping, sediment movement or loss) • Soil compaction, roughness, development and characteristics • % bare ground • Soil roughness • Surface resistance to disturbance • Bulk density • Hydraulic conductivity • Particle size and erodibility • Biocrusts • Substrate biota • Substrate deposition or loss rates • Aggregate stability • Water infiltration
Substrate - chemical	• pH • Salinity • Macronutrients and micronutrients • Heavy metals • Rates of litter mass change • Soil nutrient availability • Electrical conductivity • Radiation levels • Other edaphic factors
Water chemo-physical	• Depth to water table • Water infiltration of soil/substrate • Water holding capacity • Changes to streamflow or channel flow • Water temperature • Turbidity • Total dissolved solids • Groundwater chemistry • Wave energy • Seston and/or chlorophyll a concentrations • Dissolved oxygen • Peat humification • Precipitation • Evapotranspiration

Biophysical Monitoring Indicators *(drawn from the ISF Indicators)*	General Indicators (used in multiple ecosystems) from the SER 5-star system	
	Sub attributes	**Examples of evidence**
	Over-utilization	• Harvesting rates of species • Grazing rates • Damage to vegetation • Species composition • Hydrological modifications across landscape • Water harvesting • Mining impacts • Off-road vehicle use or damage • Road density • Degree of fragmentation
Native species richness (C) **Native species abundance (C)**	Desirable plants, fungi, and lichens Desirable animals	• Species richness and evenness • Number of desirable indicator species • Number of protected or threatened species • Cover or other measures of abundance • Functional diversity • Species call counts • Condition indices of keystone species
Invasive species (C)	No undesirable species Invasive species	• Threat of invasive species (e.g. nearby invasive crop, plantation, or garden species) • Presence of invasive species onsite • Relative richness of invasive versus native species • Relative cover or abundance of invasive species • Richness, cover, or frequency of other undesirable native species above and below ground
Ecosystem recovery (S)	Resilience/ recruitment	• Resilience to disturbance • Capability for self-replacement • Species reproduction and recruitment • Presence of different successional groups
Presence of contaminants (S)	Contamination	• Contamination from animal/livestock operations • Industrial production facilities • Mining impacts • Oil and gas production facilities • Agricultural nutrients and chemicals • Urban pollution • Air pollution • Dumping of debris • Acid, alkali, or salt production

Biophysical Monitoring Indicators	General Indicators (used in multiple ecosystems) from the SER 5-star system	
(drawn from the ISF Indicators)	**Sub attributes**	**Examples of evidence**
Reproduction and dispersal mechanisms (S)	Habitat links Intraspecific gene flows Resilience/ recruitment	• Capability for self-replacement (growth rates, seedbanks, seedling recruitment over multiple generations) • Species reproduction and recruitment (flowering, seed production, provision of seedbanks)
Ecosystem productivity (S)	Productivity, cycling	• Productivity (e.g. photosynthesis and growth) • Demographics
Disturbance regimes (S)	Other disturbance drivers	• Characteristics of natural disturbance regimes • Spatial disturbance properties • Temporal disturbance properties
Carbon sequestration (H)	Productivity, cycling	• Carbon cycling and carbon budget • Net primary production • Carbon sequestration rate • Woody biomass • Dissolved inorganic carbon • Particulate organic carbon • Carbon flux
Climate change adaptation/ disaster risk reduction (C)	Resilience/ recruitment	• Resilience to disturbance • Presence of different successional groups
Beneficial connectivity of native ecosystems (C)	Landscape flows Habitat links Intraspecific gene flows Resilience/ recruitment	• Beneficial exchanges or flows with the surrounding environment • Rate and quality of surface and groundwater flows • Migrations and other movements of organisms • Positive genetic flows of characteristic species • Genetic connectivity (e.g., genomic data) • Pollinator travel distance • Gene flow distance and dynamics • Connections with nearby remnant native vegetation • Vegetation or wildlife corridors • Habitat buffers • Landscape level habitat patch mosaics, spatial area, history, and integrity • Persistence and recovery of surrounding ecosystems

Biophysical Monitoring Indicators	General Indicators (used in multiple ecosystems) from the SER 5-star system	
(drawn from the ISF Indicators)	**Sub attributes**	**Examples of evidence**
Degradation Causes (H) **Degradation Processes (S)**	Invasive species Over-utilization Contamination Other degradation drivers	• Unbalanced disturbance regimes (e.g., inappropriate fire intervals or intensity, flooding, streambank erosion or deposition, herbivory) • Spatial disturbance properties • Temporal disturbance properties • Disease prevalence and intensity

Note: This table represents the ISF biophysical indicators mapped against the ecosystem sub-attributes used by the SER 5-star System with suggested examples of evidence that could be used to design restoration monitoring programmes
H = Headline, C = Core, S = Secondary
Sources: adapted from Gann, G. D., Walder, B., Gladstone, J., Manirajah, S. M., & Roe, S. 2022. Restoration project information sharing framework. Society for Ecological Restoration and Climate Focus. https://cdn.ymaws.com/www.ser.org/resource/resmgr/publications/restoration-project-informat.pdf; and Gann, G.D., Mosyaftiani, A., Bartholomew, D., McDonald, T., Walder, B., Young, R., Dixon, K.W. 2024. Five-star System sub-attribute Table, V1.0, for SER's International principles and standards for the practice of ecological restoration. Society for Ecological Restoration. https://www.ser.org/page/Standards-Tools

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7. REQUIRED MONITORING AND REPORTING OF TARGET 2 AT THE NATIONAL LEVEL ACROSS ECOSYSTEMS

31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
13 14 15 16 17 18 19

Ruler image: www.freepik.com

The required monitoring for Target 2 relates to agreed Headline, Component, and Complementary Indicators, and is therefore limited. Parties are expected, however, to monitor the desired outcomes of Target 2, that is, the enhancement of biodiversity and ecosystem functions and services, and ecological integrity and connectivity.

As such, additional systems for monitoring ecosystem change over time should be put into place by countries as practicable. The monitoring framework for the Kunming-Montreal Global Biodiversity Framework (CBD/SBSTTA/26/2) identifies the following indicators for Target 2:

Headline indicator:

2.1 Area under restoration

Proposed component indicators[4]*:*

Land degradation (Sustainable Development Goal Indicator 15.3.1)

Proposed complementary indicators:

Global Ecosystem Restoration Index

Proportion of Key Biodiversity Areas in favourable condition

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[4] New component indicators and complementary indicators have been proposed to SBSTTA, see page 12/29 in Annex 1 of this document: https://www.cbd.int/doc/c/31b7/f72c/2a4e93a67dedb8ce6609c232/sbstta-26-02-en.pdf. Further guidance on component and complementary indicators is forthcoming.

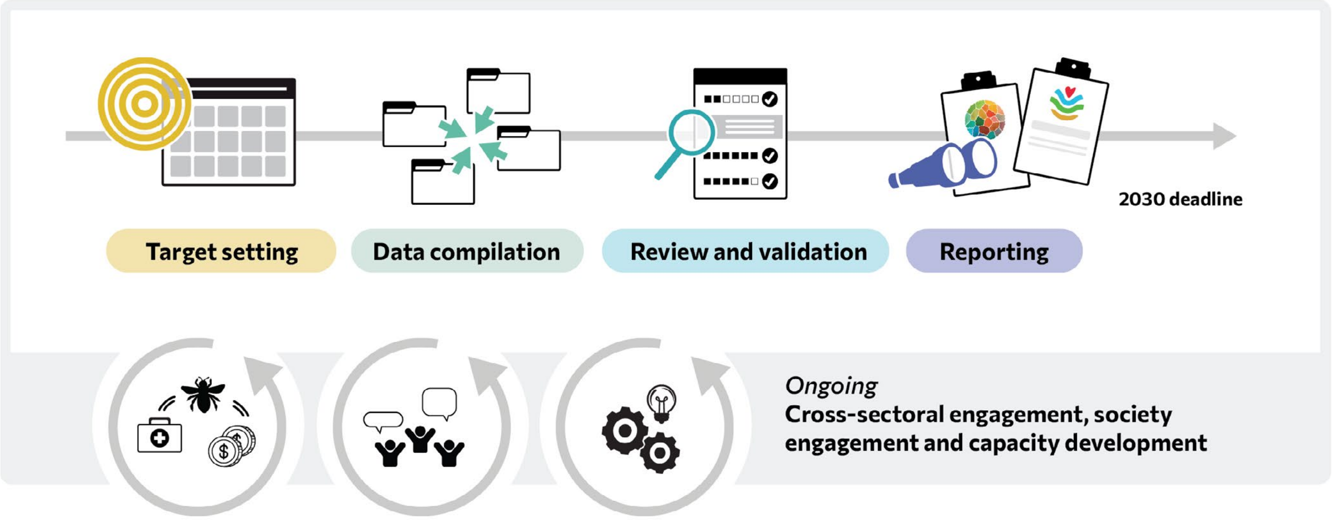
These indicators form the basis for national reporting on Target 2. Monitoring of the area under restoration is planned for a 10-year period (2021-2030) aligned with the KM-GBF Targets and the UN Restoration Decade. In November 2022, FAO, in collaboration with the UN Restoration Decade Task Force on Monitoring and the informal working group on Target 2 monitoring, developed a draft methodology for monitoring and reporting area under restoration. This methodology is applicable for reporting progress under the UN Restoration Decade, and could be disaggregated to provide data for Target 2. With this approach, a single data compilation and validation exercise for area under restoration could support monitoring and reporting requirements for multiple needs.

In addition, some proposed indicators for Goal A, such as the Red List of Ecosystems, Red List Index and the extent of natural ecosystems, can contribute to restoration projects and Target 2 assessments and monitoring (Section 3.1).

7.1 Target 2 headline indicator methodology and meta-data

FAO, as the custodian of the Target 2 headline indicator 2.1, area under restoration, is responsible for providing the methodology and guidance to monitor and report the indicator. The methodology for the headline indicator will be updated and expanded over time and is available at https://gbf-indicators.org/metadata/headline/2-2. The metadata for the indicator provides the rationale, definition, concepts, classifications, scale, linked process, recommended disaggregation, and related goals, targets and indicators from the KM-GBF. The indicator methodology is harmonized with data collection for the UN Restoration Decade, utilizing the resources and framework for global data compilation to support the national level reporting of restoration by Parties for the indicator. The proposed workflow for the indicator consists of five components: 1) target setting and planning, 2) data compilation, 3) review and validation, 4) monitoring and reporting, which are all underpinned by 5) cross-sectoral and society engagement and capacity development (Figure 7.1). Guidance for operationalizing these elements can be found in Section 6.4.

Figure 7.1 Workflow for monitoring and reporting on headline indicator 2.1, area under restoration.



Source: Authors own elaboration.

Target setting and planning

When formulating and revising restoration targets, the elements that are to be reported on and monitored should be considered (Section 3.2). The target should integrate quantifiable and clear numeric goals that enable the monitoring and reporting of progress towards meeting the target. Consistency from target setting to reporting can be facilitated by disaggregating targets by biome or ecosystem functional group (GET levels 2 or 3), indigenous and traditional territories, protected areas/other effective area-based measures, and major type of restoration activity (e.g. rehabilitation versus ecological restoration) (CBD/SBSTTA/26/2, p 12) (see Box 7.1 for more information on disaggregation).

Data compilation

Collecting data from various actors, organisations, and ministries carrying out restoration activities is referred to as data compilation. For the headline indicator Area Under Restoration, data refers to the numeric area under restoration using the appropriate units. Data compilation requires coordination and agreement to utilize common parameters to track progress and an agreed system to combine information in a clear, transparent, consistent and accurate manner. Quality assurance and quality control are important to avoid the duplication and double counting of data sources.

In support of the UN Restoration Decade, FAO is leading a data compilation effort that will integrate restoration data from various available data sources. The objective is to produce a default dataset on restoration that can contribute to national reporting, while providing more information and contextualisation on restoration progress beyond area-based estimates, including the actor leading the restoration, activities and tenure. The default dataset contains area-based estimates aggregated from restoration initiatives and projects, as well as direct country reported tabular data from existing processes (see below a and b).

a *Country reported tabular data of ecosystem restoration from multiple sources.* This may contain additional information on the type of ecosystems under restoration, restoration objectives, and other parameters. For example, the Global Forest Resources Assessment (FRA) collects country reported area of forests (ha) with the main objective "Conservation of biodiversity" and has included the area of forests under restoration (ha) in its next reporting cycle. The default dataset lists country reported tabular data from multiple sources (more examples of data sources found in Table 7.1), such as FRA, LDN, and country reporting to regional restoration targets such as the African Forest Landscape Restoration Initiative (AFR100). It cannot be further aggregated because of potential overlapping.

b *Country level data aggregated from restoration initiatives and projects.* Area under restoration may also be estimated by summing up the area of

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individual restoration initiatives and projects, removing duplicates and overlapping areas (i.e. an area should not be counted more than once). This requires collecting initiative and project level data, using a bottom-up approach that utilizes interoperability frameworks to reduce double counting (Section 7.5). A spatial database of restoration projects can help identify duplicates and overlapping areas, using appropriately defined quality control measures. The default dataset also contains country level data aggregated from initiatives and projects, by each data source.

In data collection processes, it is important to uphold the right to free, prior and informed consent of Indigenous Peoples and to ensure their data sovereignty by respecting their decisions on knowledge sharing (including open exchange, production and dissemination). It is important to acknowledge the potential risks of sharing the knowledge of Indigenous Peoples.

Review and validation

Table 7.1 shows an example of a default dataset with compiled restoration data from multiple sources for national focal points to review. National focal points are encouraged to perform a quality assessment and quality control review and decide how to aggregate different data sources for reporting. FAO is developing a dashboard for the national focal points to visualize the compiled restoration data and further guidance on the review process is forthcoming.

Table 7.1 Example of a default dataset for indicator 2.1, area under restoration, with compiled data from multiple sources.

Data parameter	Data source examples	Disaggregation			
		Ecosystems	**Indigenous and Traditional Territories**	**PA& OECMs**	**Activities**
Committed area to restore (ha)	**Nationally Determined Contributions (NDCs)**				
	UNCCD Performance Review and Implementation System (PRAIS)	X		X	
	National Biodiversity Strategies and Action Plans (NBSAPs)				
	Bonn Challenge and regional commitments (AFR100, Initiative 20×20)				
	Ramsar Convention on Wetlands	X			
	Global Restoration Commitments database (Sewell et al., 2020)				
	*Nature commitments**				
	Framework for Ecosystem Restoration Monitoring (FERM)*				

Data parameter	Data source examples	Disaggregation			
		Ecosystems	Indigenous and Traditional Territories	PA& OECMs	Activities
Area under restoration (ha)	Sustainable Development Goals Indicators Database	X			
	Forest Resources Assessment (FRA)	X			
	UNCCD Performance Review and Implementation System (PRAIS)	X			X
	REDD+ reporting mechanisms				
	Framework for Ecosystem Restoration Monitoring (FERM)∗	X	X	X	X
	World Database on Protected Areas (WDPA)∗	X			
	IUCN Restoration Barometer	X			X
	Global Peatlands Assessment	X			
	International Coral Reef Initiative (ICRI)∗	X			
	Restor*	X			X
	Society for Ecological Restoration — Restoration Resource Center*	X			X

Notes: In the Data source examples column, **Bold** *= MEA reporting mechanisms; Italic = unofficial sources (e.g. from non-state actors and research institutions); _* = project/site level databases._*
Source: Authors' own elaboration.

Reporting

Monitoring of area under restoration at the national scale requires a comprehensive and inclusive database of restoration projects and initiatives. The parameters in Table 7.2 (Section 7.3) provide a starting point for data to collect across restoration projects, in order to monitor and report the progress at a broad scale. Collection of monitoring data depends on available resources and restoration objectives and can take place through field visits and the use of remote sensors, such as satellites and drones (see also Section 6.4). For more information on the national reporting process see Section 7.4.

Cross-sectoral and society engagement and capacity development

Broad engagement of stakeholders is a cross-cutting component in the monitoring and reporting workflow and in the UN Restoration Decade SOPs (see also Section 6.4). Capacity development is driven by country actors, consistent with national priorities and the local context, and anchored in national systems and local expertise (see also Section 6.2). Capacity development needs to be undertaken in partnership with national, regional and international players and requires long-term interventions rather than stand-alone short-term approaches. Capacity development opportunities will be provided by the Target 2 Partnership, as identified in the Roadmap for Target 2.

Box 7.1 Disaggregation of area under restoration

Target 2 Headline indicator metadata recommends disaggregating total area under restoration by the following:

- By ecosystem types.
- By Indigenous and Traditional Territories (IATTs)*.
- By Protected Areas (PAs)/Other Effective area-based Conservation Measures (OECMs).
- By type of restoration activities.

A key component of Target 2 monitoring is the proposed disaggregation of ecosystems by type. Target 2 explicitly calls for restoration of three major natural ecosystem types or categories (terrestrial, inland water, coastal and marine), but also calls for the restoration of production ecosystems in order to improve delivery of ecosystem services. However, to assess the effectiveness of restoration and create opportunities for adaptive management that can improve restoration outcomes, countries should plan, implement, and monitor restoration at the highest degree of precision practicable. In some cases, this may be at the biome level (e.g. Savannas and grasslands, Rivers and streams, Marine shelfs) but finer scales are recommended since different habitats within ecosystems support different biodiversity. To facilitate this process, Target 2 monitoring methodology recommends using nationally defined ecosystems that are optimally mapped to the IUCN GET. The GET includes biomes and ecosystem functional groups for both natural and production ecosystems. Methods for relating national and global ecosystem typologies and aggregating national or subnational ecosystem classification schemes are emerging and should be applied as appropriate and updated as the field advances. Target 2 monitoring is also designed to disaggregate the two major types of restoration needed to achieve Target 2, the ecological restoration of natural ecosystems, and the rehabilitation of production or other transformed systems (Sections 2 and 6.4).

** IATTs refer to legally protected areas, including lands of Indigenous Peoples and other collective customary rights holders.*

7.2 Target 2 component indicator on land degradation

The concept of land degradation neutrality (LDN) was introduced into the global dialogue by the United Nations Convention to Combat Desertification (UNCCD), accepted by the international community during the Rio+20 conference in 2012 and adopted as Target 15.3 of the 2030 Agenda for Sustainable Development in 2015.

LDN aims to avoid/slow degradation and increase restoration efforts so that "the amount and quality of land resources necessary to support ecosystem functions and services to enhance food security remain stable, or increase, within specified temporal and spatial scales and ecosystems". More specifically, it aims to achieve no net loss of land-based natural capital and the ecosystem services that flow from it via a continuum of activities that avoid, reduce, and reverse land degradation, in line with the restorative continuum (Fig. 2.1).

Achieving neutrality requires estimating the likely impacts of land-use and land management decisions, counterbalancing anticipated losses through strategically planned rehabilitation or ecological restoration of degraded land within the same land type. The priority is to avoid degradation by eliminating its drivers while simultaneously expanding conservation and protected areas; reduce degradation through the adoption of sustainable land and water management practices in production landscapes; and reverse degradation through restoration. As such, LDN is linked and contributes to not only Target 2, but also to Target 1, 3 and 10 of the KM-GBF, among others.

As documented in the Scientific Conceptual Framework for Land Degradation Neutrality (Orr *et al.*, 2017), LDN is governed by environmental and social safeguards – a set of guiding principles aligned with the SER and UN Restoration Decade principles as well as the FAO Committee on Food Security's Voluntary Guidelines on the Responsible Governance of Tenure (FAO, 2022).

As of August 2024, 131 of the 196 country Parties to the UNCCD have pledged to achieve LDN by 2030 and 112 countries have already set their LDN targets and measures through their participation in the UNCCD's LDN Target Setting Programme.[5]

It has been estimated that of the 1 billion hectares in restoration commitments made by countries across all global processes through 2020, almost half are LDN targets (Sewell *et al.*, 2020).

As part of their work under the LDN Target Setting Programme, countries have established land degradation baselines using best available data and the internationally agreed methodology for SDG Indicator 15.3.1.[6] In the 2022 national reporting process to the UNCCD, 115 countries reported estimates of land degradation. By complementing these country-reported estimates with 52 additional national estimates derived from global data sources, it has been estimated that between 2015 and 2019, at least 100 million hectares of healthy and productive land were degraded every year (SDG Report 2023: Special Edition). If these trends persist, the world will have to restore a staggering 1.5 billion hectares of degraded land by 2030 to achieve neutrality.

Both SDG Target 15.3 and Target 2 of the KM-GBF aim at restoring degraded land and ecosystems and can therefore strongly reinforce each other. More specifically, national LDN targets and related measures can contribute to the attainment of Target 2 for terrestrial ecosystems and should be planned jointly and accounted for in the NBSAPs. It is also important to note that the definition of effective restoration under Target 2 of the KM-GBF includes not just neutrality, but balanced net gain for people and nature. LDN provides important progress toward that goal.

Country Parties to the CBD may consider using SDG Indicator 15.3.1 as a proxy for terrestrial ecosystem degradation to set a baseline for tracking progress towards Target 2. However, data collection methodologies will have to be harmonized to enable a new quantification of global commitments and of the gaps between commitments and action taken.

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[5] For more information about the Programme, go to: https://www.unccd.int/land-and-life/land-degradation-neutrality/projects-programmes/ldn-target-setting

[6] See Good Practice Guidance for SDG Indicator 15.3.1 at: https://www.unccd.int/resources/manuals-and-guides/good-practice-guidance-sdg-indicator-1531-proportion-land-degraded

7.3 The Framework for Ecosystem Restoration Monitoring

The Framework for Ecosystem Restoration Monitoring (FERM) was collaboratively developed and launched in 2022 through the joint efforts of the UN Restoration Decade FAO-led Task Forces on Monitoring and Best Practices, as the monitoring framework of the UN Restoration Decade, which also supports countries in reporting area under restoration for Target 2.

The FERM aims to collect and harmonize area-based data on ecosystem restoration projects and programmes of different spatial scales, and to enable interoperable data exchange with other platforms. Currently, the FERM includes a registry of restoration initiatives and their good practices from all major ecosystem types, a geospatial tool for visualising restoration data, and a search engine for consulting good practices on ecosystem restoration.

The FERM Registry enables restoration stakeholders and national entities to share information on restoration progress and contributions at different scales. The registry is interoperable with other monitoring platforms, ensuring transparency in reporting and monitoring efforts (Section 7.5). While the submission of data on restoration effectiveness and impacts is optional, it is encouraged.

Based on the recommendations of the CBD Parties, the FERM geospatial platform will be regularly enhanced to meet the monitoring and reporting needs of the UN Restoration Decade and Target 2 of the KM-GBF, including the parameters required to report on indicator 2.1, area under restoration.

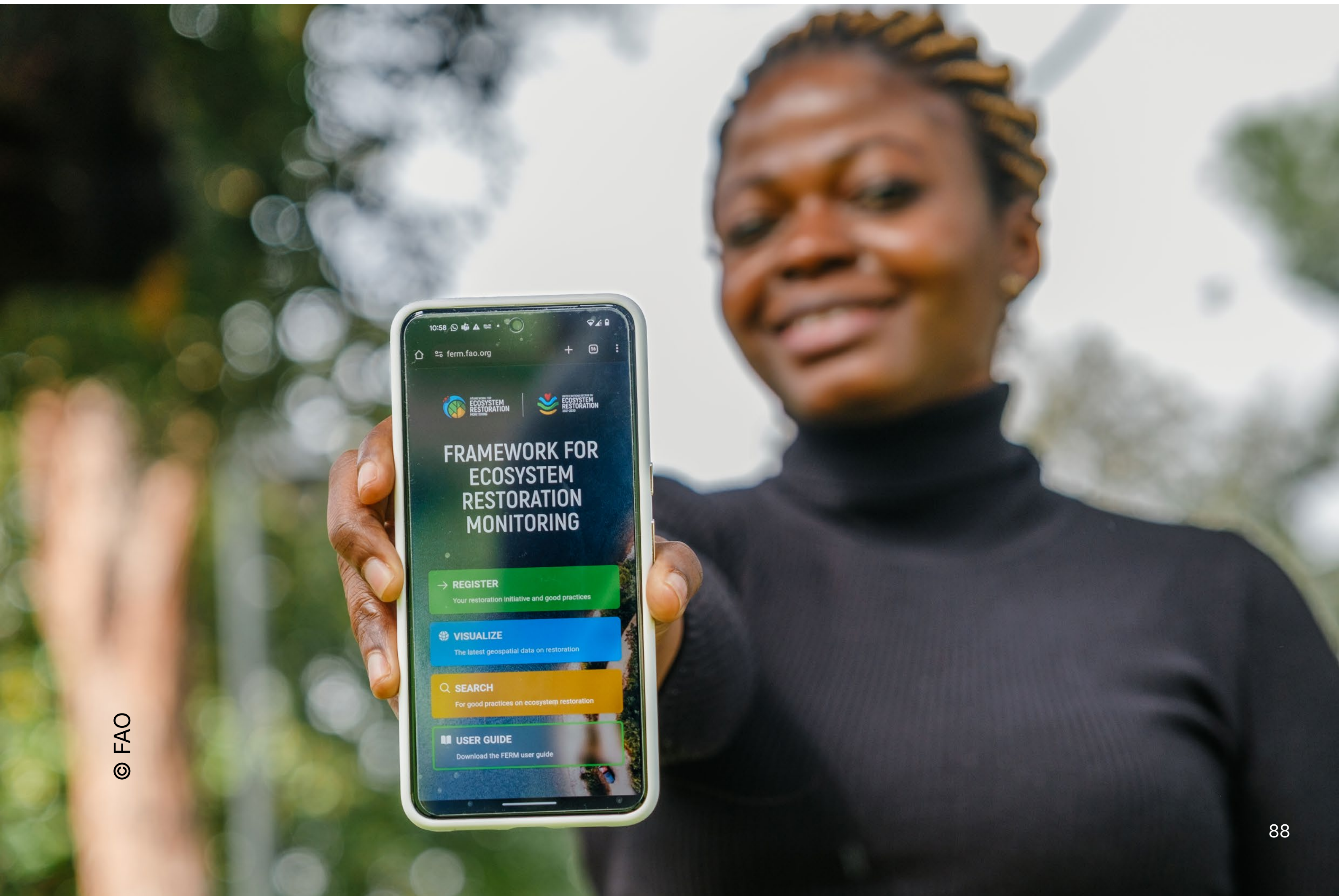
ferm.fao.org
ECOSYSTEM RESTORATION
FRAMEWORK FOR ECOSYSTEM RESTORATION MONITORING
REGISTER
Your restoration initiative and good practices
VISUALIZE
The latest geospatial data on restoration
SEARCH
For good practices on ecosystem restoration
USER GUIDE
Download the FERM user guide

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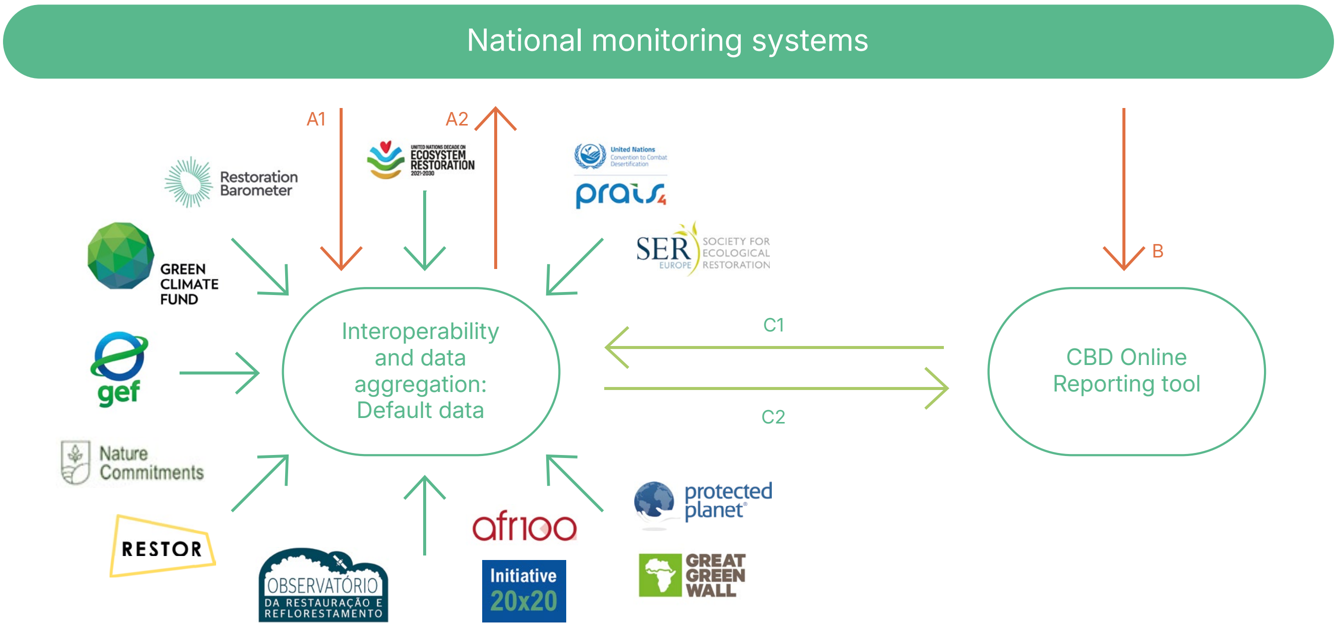
Figure 7.2 The FERM interoperability and default data.


National monitoring systems
A1
A2
B
Restoration Barometer
United Nations Decade on Ecosystem Restoration 2021-2030
United Nations Convention to Combat Desertification
prais4
SER Europe Society for Ecological Restoration
Green Climate Fund
gef
Nature Commitments
RESTOR
Interoperability and data aggregation: Default data
C1
C2
CBD Online Reporting tool
afr100
Initiative 20x20
Observatório da Restauração e Reflorestamento
protected planet
Great Green Wall

Notes: The FERM interoperability and default data works across platforms and frameworks to align the parameters that are used to monitor and report areas under restoration. Data from platforms and frameworks are aggregated into a default dataset, shared through the FERM, where national focal points can review and optionally use the information to complement national monitoring systems and national data collection (arrow a2). National monitoring systems can also be linked to FERM to share data directly (arrow a1), ensuring the alignment to Target 2 reporting. The default data will be communicated directly to the CBD Online Reporting Tool (ORT) (arrow c2), where national focal points report the implementation of KM-GBF and all the indicators, including Target 2 indicators. In the ORT, national focal points can validate the prepopulated default data as estimated data, or directly report new values using information from national monitoring systems (arrow b). The country directly reported values will be pushed back to FERM to update the default data (arrow c1).

Table 7.2 FERM registry fields and descriptions.

Requirement	Field name	Type	Accepted values and description
Mandatory	Title	Free text	Name of the initiative
Optional	Description	Free text	Short description of the initiative
Optional	Website	Free text	Links to the website of the initiative
Mandatory	Starting year	Numeric	Start year of interventions/activities
Mandatory	Ending year	Numeric	End year of interventions/activities
Mandatory	**Restoration status**	Categorical	Allowed values: in planning; in progress; post-completion monitoring
Mandatory	**Restoration types**	Categorical	Allowed values: ecological restoration; rehabilitation; not reported

Require-ment	Field name	Type	Accepted values and description
Mandatory	**Tenure status**	Categorical	Allowed values: Communal; Government; Indigenous and Traditional Territories (ITTs); Jointly owned; Private; Not reported
Mandatory	**Objectives**	Categorical	Enhance biodiversity; Enhance ecosystem functions and services; Improve ecological integrity; Improve connectivity; Other
Optional	Contribution to SDGs	Categorical	Allowed values: 17 Sustainable Development Goals
Optional	Document	File	Upload project or initiative document
Mandatory	Points of contact name	Free text	Name of the contact who can be contacted for acquiring knowledge about the initiative; may or may not be the one entering data; at least one point of contact
Mandatory	Points of contact email	Free text	Email of the contact who can be contacted for acquiring knowledge about the initiative
Mandatory	Points of contact organisation	Free text	Organization of the contact who can be contacted for acquiring knowledge about the initiative
Optional	Keywords	Free text	Keywords describing the initiative
Mandatory	**Organization name**	Free text	Name of the organization that implements or executes the initiative; at least one leading organisation
Optional	Organization acronym	Free text	Acronym of the organisation that implements or executes the initiative
Mandatory	Organization role	Categorical	Allowed values: leading; supporting
Mandatory	**Organization type**	Categorical	Allowed values: Government; NGO; Public Private Partnership; Multilateral; Foundation; Private sector; Academic & research; Other
Mandatory	**Committed area to restore**	Numeric	Numeric value of pledges, targets, aspirations, or commitments of area to restore
Mandatory	**Total area under restoration (reported)**	Numeric	Numeric value of the extent where restoration is happening
Mandatory	**Unit of area**	Categorical	Allowed values: hectare; sq km; linear km
Mandatory	Country	Categorical	Allowed values: ISO 3166 name of country where the restoration area is located. Separated by a semi-colon if multiple
Mandatory	Area	Point; Polygon	Points or delineated area of the restoration initiative; at least one point or polygon
Optional	Site name	Free text	Name of the site

Requirement	Field name	Type	Accepted values and description
Optional	Disaggregated area (reported)	Numeric	Numeric value of the extent of site
Mandatory	**Ecosystem GET level 2&3**	Categorical	Allowed values: IUCN GET version 2.0 biomes and EFGs
Mandatory	**Activities**	Categorical; Free text	Allowed values: Activities adapted from IPBES/ TEER and/or customised activities
Optional	Indicator	Categorical; Free text	Allowed values: AURORA indicators and/or customised indicators (e.g. ISF indicators)

Useful links:
Ecosystem Restoration e-learning course that includes practical lesson on using the FERM: https://www.fao.org/ecosystem-restoration-monitoring/about/gbf-target-2/course/en
FERM User guide: https://ferm.fao.org/docs/ferm_user_guide_draft.pdf

7.4 National reporting

According to CBD COP Decision 15/6, Parties will report the implementation of KM-GBF directly using CBD's Online Reporting Tool (ORT). CBD has updated the ORT and provides a demonstration of its use, available here. In the decision 15/6, Parties are requested to submit their seventh national report by 28 February 2026 and their eighth national report by 30 June 2029 to enable the preparation of the global reviews, as per Article 26 of the Convention, using the template provided in Annex II. Parties are also requested to use the monitoring framework of the KM-GBF, adopted in Decision 15/5, in their national reports, supplemented, as appropriate, by optional component and complementary indicators also included therein as well as other relevant national indicators. This reporting, as well as the corresponding data collection and compilation process, is led by Parties. FAO is working with CBD to link the FERM to CBD's ORT to provide default data to prepopulate the ORT as described in Figure 7.2. CBD's ORT includes only tabular data while the FERM includes geospatial information on restoration initiatives and projects that can be used as an input for national scale reporting to the CBD. Additionally, the FERM team envisions creating a global map to showcase restoration areas (as polygons or points) which would be useful for national analysis and further monitoring of restoration areas.

7.5 Data sharing and interoperability

Interoperability refers to the ability of two systems or components to exchange information and use the information that has been exchanged. This exchange, however, must take into consideration issues of data security and data sovereignty, which is vital to maintaining trust and collaboration among stakeholders and right and knowledge holders. Various platforms and established processes collect data on ecosystem restoration. The objective of building an interoperability framework for reporting area under restoration, and, as appropriate, other restoration information, is to enable the exchange and integration of data from different sources, therefore reducing duplication of effort and reporting burden, while minimising double counting when possible. This integration is crucial for enhancing the incorporation of data from numerous smaller projects into national, regional and global platforms, by facilitating data consistency and a data sharing framework. This approach not only streamlines data management but also enhances the accuracy and reliability of reported data. The Restoration Project Information Sharing Framework (ISF) developed by the Global Restoration Observatory (Gann *et al.*, 2022) provides a useful framework for interoperability between project-level databases and platforms (see also Section 6.4).

Multiple global platforms, including both voluntary and unofficial reporting mechanisms, and official MEA-linked reporting mechanisms collect information on Area Under Restoration (see examples in Table 7.1, column Data source examples) (see Case Study 7.1). The FERM aims to make restoration data easily accessible in one place and clearly attributed, to improve the flow of the information, to increase consistency in reporting, and to reduce the reporting burden.

Countries can use national databases, or the data compiled by FAO in the FERM interoperability framework (the default dataset described), or a combination of the databases for national reporting on Target 2. The interoperability framework can also be applied directly by a country to harmonize restoration data collection mechanisms from local to national scale, or across ministries and sectors. In addition to the benefits of data aggregation and sharing, it is important that standardized terminology and metrics are developed to enable genuine comparison across jurisdictions, both globally and at the national level (Bell-James *et al.*, 2024).

Case study 7.1 African Forest Landscape Restoration Initiative (AFR100) —

an application of FERM interoperability

The African Forest Landscape Restoration Initiative (AFR100) is a partnership of African countries launched at COP21 in Paris by the African Union Development Agency (AUDA-NEPAD), World Resources Institute (WRI), Germany's Federal Ministry for Economic Cooperation and Development (BMZ) and the World Bank. AFR100 aims to bring 100 million hectares of land in Africa into restoration by 2030, with the goals to i) accelerate restoration to enhance food security, ii) increase climate change resilience and mitigation, and iii) combat rural poverty.

The monitoring platform of AFR100 provides data and information for monitoring forest landscape restoration in Africa. It contains a survey for the status reports from implementing partners on forest restoration efforts and their impact, a GIS platform with information about country projects, hectares gain and loss, and a dashboard for data visualisation.

The AFR100 survey collects the following parameters that are identical to FERM: starting and ending year of interventions, tenure status, total area under restoration (reported), project location (polygons), and restoration activities/interventions. Ecosystems and restoration types can be derived by establishing a mapping relationship, which is an ongoing process. An API will be built in the future to enable seamless data sharing between AFR100 and FERM.

Aggregated country-level data in the AFR100 monitoring platform will be integrated into the FERM dashboard. In addition, individual projects will be available in the FERM search engine. This can significantly enhance project visibility and facilitate better information sharing.

Glossary[7]

Connectivity (ecological). See Ecological connectivity.

Degradation (of an ecosystem) — 1) A persistent deterioration of the attributes of an ecosystem (e.g. abiotic condition, species composition, ecosystem structure and function, external exchanges) relative to reference conditions, due to direct (e.g. unsustainable resource use, land use change, overexploitation, contamination) or indirect (e.g. climate change) human intervention, that affects the ecosystem's capacity to provide benefits to people and nature. (Nelson *et al.*, 2024) 2) A level of deleterious human impact to ecosystems that results in the loss of biodiversity and simplification or disruption in their composition, structure and functioning, and generally leads to a reduction in the flow of ecosystem services (Gann *et al.*, 2019).

Ecological connectivity — The unimpeded movement of species, connection of habitats without hindrance, and the flow of natural processes that sustain life on Earth (UNEP/CMS/Resolution 14.16). See also "Guidelines for conserving connectivity through ecological networks and corridors" (Hilty *et al.*, 2020).

Ecological integrity — An ecosystem's capacity to maintain its characteristic composition, structure, functioning and self-organization over time within a natural range of variability (Pimentel and Edwards, 2000).

Ecosystem restoration — The process of halting and reversing degradation, resulting in improved ecosystem services and recovered biodiversity. Ecosystem restoration encompasses a wide continuum of practices, depending on local conditions and societal choice (UNEP, 2021; FAO *et al.*, 2021). See also "Principles for ecosystem restoration to guide the United Nations Decade 2021–2030" (FAO *et al.*, 2021).

Ecological restoration — One of a broad array of restorative management activities that are considered ecosystem restoration under the UN Restoration Decade. Ecological restoration is broadly defined as the process of assisting in the recovery of an ecosystem that has been damaged, degraded or destroyed (Gann *et al.*, 2019). It differs from other ecosystem restoration activities in that it aims to recover a natural ecosystem or landscape to the condition it would be in had degradation not occurred, while allowing for environmental change (such as increases in temperature or variation in precipitation patterns caused by climate change). Ecological restoration seeks to recover biodiversity and ecosystem integrity, while delivering ecosystem services and ensuring human well-being. The conservation and restoration of biological diversity is a primary goal.

Forest (and) Landscape Restoration (FLR) — This concept emerged in 2000 and has since gained significant policy relevance reflected by the adoption of the Bonn Challenge. The Global Partnership on Forest and Landscape Restoration defines FLR as "a process that aims to regain ecological functionality and enhance human well-being in deforested or degraded landscapes" (Besseau *et al.*, 2018). FLR is not an end in itself, but a means of regaining, improving, and maintaining vital ecological and social functions, in the long term leading to more resilient and sustainable landscapes. Many types of ecosystem restoration interventions are used to implement FLR, which aims to improve both ecological and social conditions across a mosaic of land uses.

Indigenous Peoples' biocentric restoration — Indigenous Peoples' biocentric and biocultural restoration are recognized as inclusive and rights-based, and grounded in the knowledge of territorial management of Indigenous Peoples. From a biocentric perspective, Indigenous Peoples place their cosmogony and belief systems, the environment and biodiversity at the centre of their restoration practices, in both natural and semi-natural ecosystems. (Nelson *et al.*, 2024).

Indigenous Peoples´ Knowledge — There is no single definition of Indigenous Knowledge. For our purposes, we understand ‘Indigenous Knowledge’ as a term that refers to a set of complex knowledge systems based on the worldviews of Indigenous Peoples. Indigenous Knowledge reflects the unique cultures, languages, values, histories, governance and legal systems of Indigenous Peoples. It is place-based, cumulative and dynamic. Indigenous Knowledge systems involve living well with, and being in relationship with, the natural world. Indigenous Knowledge systems build upon the experiences of earlier generations, inform the practice of current generations, and evolve in the context of contemporary society. It is important to note that some Indigenous communities are struggling to maintain their Indigenous Knowledge due to ongoing impacts of colonialism. To ensure Indigenous Peoples have data sovereignty, it is important to respect their decisions on knowledge sharing, and ensuring their access, use and control over their data.

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[7] See also KM-GBF Glossary, https://www.cbd.int/doc/c/c3ab/388d/950ddc02586468a814120acf/wg2020-05-04-en.pdf

Inland waters — Aquatic-influenced environments located within land boundaries. This definition includes all possible kinds of inland water body or ecosystem, or components thereof, including groundwater.

Land degradation — 1) The many processes that drive the decline or loss in biodiversity, ecosystem functions or their benefits to people; includes the degradation of all terrestrial ecosystems (IPBES, 2018b). 2) The loss of biological or economic productivity and complexity in agricultural, range or forest land due to processes arising from human activities, such as the erosion or deterioration of soil and the loss of natural vegetation (UNCCD, 2019).

Land Degradation Neutrality (LDN) — The UNCCD defines this as “a state whereby the amount and quality of land resources necessary to support ecosystem functions and services to enhance food security remain stable, or increase, within specified temporal and spatial sales and ecosystems.”

Landscape — A bounded area (at any spatial scale) of interacting ecosystems with discrete ecological composition, structures and functions, and human communities with discrete socioeconomic and cultural characteristics (Nelson *et al.*, 2024).

Natural ecosystems (habitats) — Areas composed of viable assemblages of plant and/or animal species of largely native origin and/or where human activity had not essentially modified an area's primary ecological functions and species composition. (Based on UNEP-WCMC definition of natural habitats). https://www.cbd.int/doc/c/c3ab/388d/950d-dc02586468a814120acf/wg2020-05-04-en.pdf

Net gain — A positive improvement from restoration’s contributions to biodiversity, ecosystem integrity and human well-being, using the degraded state as a baseline, and measured at appropriate temporal and spatial scales. Measurement of net gain should include intended as well as unintended consequences of restoration activities, within and outside the restoration site. Because net gain by definition is measured against the degraded baseline, it only applies to ecosystems that have been degraded (i.e. it is not appropriate to measure net gain of non-degraded ecosystems) (Nelson *et al.*, 2024, modified from outputs of the third Global Forum on Ecological Restoration, hosted by SER and IUCN CEM, 2021).

Production ecosystems — Systems that society relies on for food, feed and fibre production. In these systems ecosystem restoration is primarily seen as contributing to healthy and stable ecosystems, which in turn support human needs for sustainable food production and livelihoods (FAO, 2020a).

Reclamation — The process of making severely degraded land (e.g. former mine sites or wastelands) fit for cultivation or a state suitable for some human use, such as its former or an alternative land use. Historically, it has also been used to describe the formation of productive land from the sea through the process of transformation (Adapted from Gann *et al.*, 2019; Young *et al.*, 2022).

Recovery — The process by which an ecosystem regains its composition, structure and function relative to the levels identified for the reference ecosystem. In restoration, recovery usually is assisted by restoration activities; recovery can be described as partial or full (Gann *et al.*, 2019).

Reference model — A model that characterizes the ecological condition that the restoration project site would be in if degradation had not occurred. Because an inherent property of ecosystems is that they change over time, the goal of this model is not to characterize pre-disturbance conditions, but rather the condition that the site would have been in now, which incorporates potential change over time. The reference model provides information on mean and variation in each element of ecosystem integrity, including species composition, ecosystem structure and functions, physical conditions, and ecological connectivity with the larger landscape or seascape. Reference models are developed using multiple sources of information. Best practice is to construct reference models empirically from a suitable number of reference sites, augmented with best available information from multiple other sources. For heavily impacted landscapes, there may be an insufficient number of (or no) available reference sites. In these cases, other information sources, such as successional models and historical information from natural and written archives, must be used to construct a theoretical reference model (adapted from Nelson *et al.*, 2024; Gann *et al.*, 2019).

Reference site — A site that is environmentally similar to the project site (site to undergo restoration) but that has experienced little to no anthropogenic degradation. Where available, an appropriate number of reference sites can be used to reliably characterize the mean condition (and range of variability) that the restoration project site would have been in had degradation not occurred (Adapted from Gann *et al.*, 2019; Nelson *et al.*, 2024).

Rehabilitation — Management actions that reinstate attributes of some physical properties (e.g. soils, water) and a level of ecosystem functioning on degraded or transformed sites, along with renewed and ongoing provision of a level of ecosystem services. Native biodiversity and ecosystem integrity are supported but actions do not achieve substantive recovery of a natural ecosystem.

Restoration — The term restoration, in the broad sense, is generally consistent with the definition of ecosystem restoration, but can also be used to refer to ecological restoration, Forest Landscape Restoration, or even broader concepts, some of which have a stronger emphasis on human well-being.

Restoration ecology — The branch of ecological science that provides concepts, models, methodologies and tools for the practice of ecological restoration. It also benefits from direct observation of and participation in restoration practice. (Gann *et al.*, 2019)

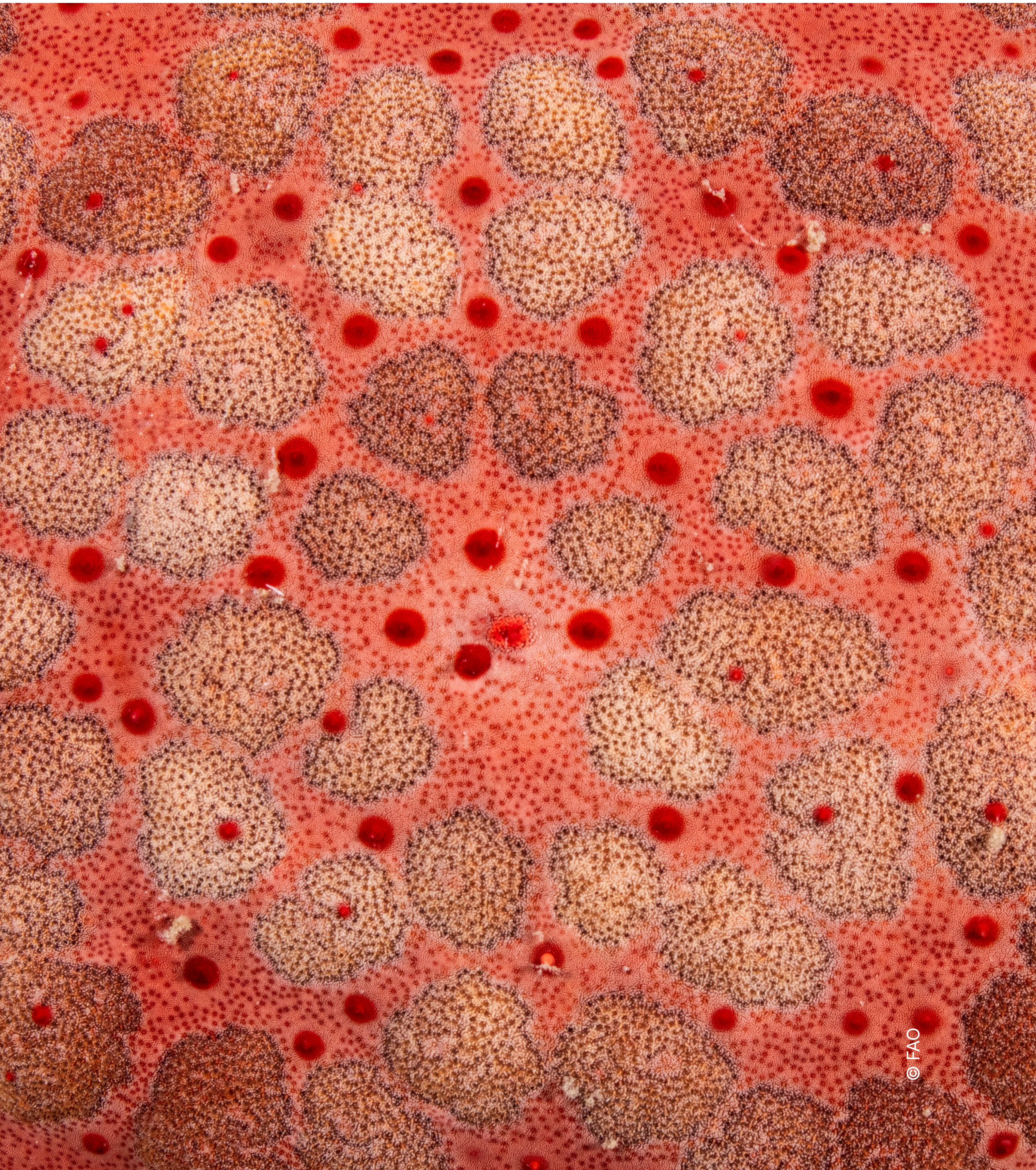
Restorative continuum — The range of ecosystem restoration activities ordered based on the degree to which they recover biodiversity, ecosystem health and integrity, and human well-being. At one end of this continuum are management activities aimed at reducing societal impacts, such as runoff into urban streams, and mitigating threats such as contaminated soils. The other end of the continuum includes ecological restoration, which aims to both remove degradation and recover ecosystems to the condition that they would be in had degradation not occurred, while allowing for environmental change. (Nelson *et al.*, 2024, adapted from the definition by Gann *et al.*, 2019)

Rewilding — The process of rebuilding–following major human disturbance–a natural ecosystem by restoring natural processes and the complete or near complete food web at all trophic levels as a self-sustaining and resilient ecosystem with biota that would have been present had the disturbance not occurred (Carver *et al.*, 2021). Some consider rewilding as a unique component of ecological restoration, while others consider it to be its own discipline.

Rights and knowledge holders — Any person, group of persons or entity who holds customary or legal use rights, in accordance with the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) and national laws or traditions, and the recommendations of the United Nations Permanent Forum on Indigenous Issues (UNPFII). (Adapted from Nelson *et al.*, 2024, Preferred by Nature's 2022). In some parts of the world (e.g. Canada) knowledge holders are a distinct subset of individuals within rights holder communities.

Seascape — A bounded area of interacting ecosystems (at any spatial scale) in marine environments, with discrete ecological composition, structures and functions, and human communities with discrete socioeconomic and cultural characteristics. (Nelson *et al.*, 2024)

Semi-natural ecosystems — In the European Union (EU) legal context, these are biodiverse ecological assemblages created by human activities (e.g. grazed or mowed alpine meadows). They have evolved under traditional agricultural, pastoral or other human activities that can be centuries old and depend on traditional management for their characteristic composition, structure and function. These ecosystems are highly valued for their biodiversity and ecosystem services and can be a reference for ecological restoration. Examples include alpine and lowland meadows, heathlands, chalk grasslands, coppice forests, wood pastures and grazing marshes. They differ from "cultural ecosystems," as defined by the European Union, created to provide ecosystem services, but that result in degraded ecosystems with lower biodiversity values. Examples include arable fields, species-poor agricultural grasslands, mineral extraction areas and urban landscapes with city parks. These are not appropriate as a reference for ecological restoration but can be the starting point for ecological restoration or rehabilitation. (Modified from Gann *et al.*, 2019)



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Annex A. What is degradation?

In general terms, degradation means the loss of integrity or quality. Applied to different contexts, degradation takes on different nuances (IPBES, 2018b). In the STAPER, degradation is characterized by a decline or loss of biodiversity or ecosystem functions. Degradation and restoration are considered context-specific and refer to both the state of ecosystems and to ecosystem processes. In the context of the UN Restoration Decade, degradation has been defined as a persistent deterioration of ecosystem attributes (e.g. abiotic condition, species composition, ecosystem structure and function, external exchanges) relative to reference conditions, due to direct (e.g. unsustainable resource use, land use change, overexploitation, contamination) or indirect (e.g. climate change) human intervention, that affect the ecosystem's capacity to provide benefits to people and nature (Nelson *et al.*, 2024). In reference to the ecological restoration of natural ecosystems, degradation is a level of deleterious human impact to ecosystems that results in the loss of biodiversity and simplification or disruption in their composition, structure and functioning, and generally leads to a reduction in the flow of ecosystem services (Gann *et al.*, 2019).

Degradation is also used in the expression land degradation, which elicits several meanings in different contexts. For example, used broadly, land degradation refers to the decline or loss in biodiversity, ecosystem functions or services, and includes the degradation of all terrestrial ecosystems including associated aquatic ecosystems that are impacted by land degradation (IPBES, 2018a). In the context of Land Degradation Neutrality, the UNCCD (2019) has defined land degradation as the loss of biological or economic productivity and complexity in agricultural, range or forest land due to processes arising from human activities, such as the erosion or deterioration of soil and the loss of natural vegetation. Because the term land degradation is not specific to any particular type of ecosystem, the transformation of natural ecosystems into economically productive ones, such as rangelands and agricultural systems, usually causes the loss of quality to one and an increase in the other. Therefore, it is critical to understand the desired outcome of restoration to assess degradation.

The System of Environmental-Economic Accounting (2021) defines ecosystem degradation as the decrease in the value of an ecosystem asset over an accounting period that is associated with a decline in the condition of an ecosystem asset during that accounting period. The decrease in value will be demonstrated by a fall in the net present value of expected future returns of the ecosystem services supplied by that asset. Ecosystem degradation will arise as the result of both managed and unmanaged declines in condition.

Degradation is often used in conjunction with more specific terms (simplified from IPBES [2018b]), such as: biodiversity degradation (loss of habitat or species), freshwater degradation (loss of quantity or quality of water, desirable biodiversity components, or hydrological functions), degradation of marine habitats (reduced percentage cover of coral or area of seagrass or oyster reef), rangeland degradation (loss of features that diminish its capacity to support herbivores), and soil degradation (loss of quantity or quality, including physical and chemical components).

Because the concept of degradation is context-specific, there may be challenges or conflicts in defining degradation for certain types of ecosystems, especially those that provide both biodiversity and production benefits. This is critical to note for some ecosystems such as natural grasslands that serve as rangelands or coastal and marine ecosystems that support fisheries. Increased productivity in either, e.g. through stock enhancement, may be a form of degradation for the underpinning natural ecosystem.

Annex B. A history of the concept of effective restoration

An early reference to the idea of effective restoration was published by Higgs in 1997, in which he tied it to ecological fidelity. Ecological fidelity, in turn, comprised structural/compositional replication, functional success and durability. The concept of effective restoration was broadened and elevated as one of three guiding principles in the "Principles and guidelines for ecological restoration in Canada's protected natural areas" (2008): effective, efficient, and engaging.

The first global guidelines for ecological restoration in protected areas were published in 2012. Guidelines for effective restoration included:

- Do no harm by first identifying when active restoration is the best option.

- Re-establish ecosystem structure, function and composition.

- Maximize the contribution of restoration actions to enhancing resilience.

- Restore [ecological] connectivity within and beyond the boundaries of protected areas.

- Encourage and re-establish traditional cultural values and practices that contribute to the ecological, social and cultural sustainability of the protected area and its surroundings.

- Use research and monitoring, including from traditional ecological knowledge, to maximize restoration success.

In the STAPER, the concept of effective restoration was broadened further to include concepts such as capacity-building, training, technology transfer and cost-effectiveness.

The SER Standards Summary document (2019) stated: "Ecological restoration, when implemented effectively and sustainably, contributes to protecting biodiversity; improving human health and well-being; increasing food and water security; delivering goods, services, and economic prosperity; and supporting climate change mitigation, resilience, and adaptation."

Key text from the UN Restoration Decade Standards of Practice state: "To be considered ecosystem restoration, however, the activity must result in net gain for biodiversity, ecosystem health and integrity, and human well-being, including sustainable production of goods and services." Effective restoration then, at a minimum, must accomplish these items.

A 2021 guidance document for effective restoration measures for species and habitats in the European Union identified the following challenges and dilemmas for effective restoration:

- Proper understanding of ecosystem functioning, i.e. abiotic conditions and processes, including natural hydrology, natural disturbances and natural gradients in nutrient availability;

- Proper understanding of species (meta) functioning, i.e. dynamics, reproduction success, genetics, dispersal capacity, food resources, ecological traps, and extinction debt;

- Understanding current ecosystem species composition and function regarding historical land use and pressures;

- Facilitating recolonization of characteristic flora, fauna and vegetation types following the restoration and management of abiotic attributes (e.g. topography, hydrologic systems);

- Improving ecological resilience regarding pressures and threats at the landscape level, for example, fragmentation, acidification, nitrogen deposition and climate change; and

- Avoiding and controlling the encroachment of invasive alien species.

Annex C. Considerations for the implementation of the Kunming-Montreal Global Biodiversity Framework

The Kunming-Montreal Global Biodiversity Framework, including its Vision, Mission, Goals and Targets, is to be understood, acted upon, implemented, reported and evaluated, consistent with the following (Section C of the KM-GBF; CBD, 2024).

a Contribution and rights of indigenous peoples and local communities
The Framework acknowledges the important roles and contributions of indigenous peoples and local communities as custodians of biodiversity and as partners in its conservation, restoration and sustainable use. The Framework's implementation must ensure that the rights, knowledge, including traditional knowledge associated with biodiversity, innovations, worldviews, values and practices of indigenous peoples and local communities are respected, and documented and preserved with their free, prior and informed consent, including through their full and effective participation in decision-making, in accordance with relevant national legislation, international instruments, including the United Nations Declaration on the Rights of Indigenous Peoples,* and human rights law. In this regard, nothing in this framework may be construed as diminishing or extinguishing the rights that indigenous peoples currently have or may acquire in the future;

b Different value systems
Nature embodies different concepts for different people, including biodiversity, ecosystems, Mother Earth, and systems of life. Nature's contributions to people also embody different concepts, such as ecosystem goods and services and nature's gifts. Both nature and nature's contributions to people are vital for human existence and good quality of life, including human well-being, living in harmony with nature, and living well in balance and harmony with Mother Earth. The Framework recognizes and considers these diverse value systems and concepts, including, for those countries that recognize them, rights of nature and rights of Mother Earth, as being an integral part of its successful implementation;

c Whole-of-government and whole-of-society approach
This is a framework for all — for the whole of government and the whole of society. Its success requires political will and recognition at the highest level of government and relies on action and cooperation by all levels of government and by all actors of society;

d National circumstances, priorities and capabilities
The goals and targets of the Framework are global in nature. Each Party would contribute to attaining the goals and targets of the Framework in accordance with national circumstances, priorities and capabilities;

e Collective effort towards the targets
The Parties will catalyse implementation of the Framework through mobilisation of broad public support at all levels;

f Right to development
Recognizing the 1986 United Nations Declaration on the Right to Development,** the Framework enables responsible and sustainable socioeconomic development that, at the same time, contributes to the conservation and sustainable use of biodiversity;

g Human rights-based approach
The implementation of the Framework should follow a human rights-based approach, respecting, protecting, promoting and fulfilling human rights. The Framework acknowledges the human right to a clean, healthy and sustainable environment;***

h Gender
Successful implementation of the Framework will depend on ensuring gender equality and empowerment of women and girls, and on reducing inequalities;

i Fulfilment of the three objectives of the Convention and its Protocols and their balanced implementation
The goals and targets of the Framework are integrated

and are intended to contribute in a balanced manner to the three objectives of the Convention on Biological Diversity. The Framework is to be implemented in accordance with these objectives, with the provisions of the Convention on Biological Diversity, and with the Cartagena Protocol on Biosafety and the Nagoya Protocol on Access and Benefit-sharing, as applicable;

j Consistency with international agreements or instruments
The Framework needs to be implemented in accordance with relevant international obligations. Nothing in this Framework should be interpreted as agreement to modify the rights and obligations of a Party under the Convention or any other international agreement;

k Principles of the Rio Declaration
The Framework recognizes that reversing the loss of biological diversity, for the benefit of all living beings, is a common concern of humankind. Its implementation should be guided by the principles of the Rio Declaration on Environment and Development;****

l Science and innovation
The implementation of the Framework should be based on scientific evidence and traditional knowledge and practices, recognizing the role of science, technology and innovation;

m Ecosystem approach
This Framework is to be implemented based on the ecosystem approach of the Convention;*****

n Intergenerational equity
The implementation of the Framework should be guided by the principle of intergenerational equity which aims to meet the needs of the present without compromising the ability of future generations to meet their own needs and to ensure meaningful participation of younger generations in decision-making processes at all levels;

o Formal and informal education
Implementation of the Framework requires transformative, innovative and transdisciplinary education, formal and informal, at all levels, including science-policy interface studies and lifelong learning processes, recognizing diverse world views, values and knowledge systems of indigenous peoples and local communities;

p Access to financial resources
The full implementation of the Framework requires adequate, predictable and easily accessible financial resources;

q Cooperation and synergies
Enhanced collaboration, cooperation and synergies between the Convention on Biological Diversity and its Protocols, other biodiversity-related conventions, other relevant multilateral agreements and international organisations and processes, in line with their respective mandates, including at the global, regional, subregional and national levels, would contribute to and promote the implementation of the Framework in a more efficient and effective manner;

r Biodiversity and health
The Framework acknowledges the interlinkages between biodiversity and health and the three objectives of the Convention. The Framework is to be implemented with consideration of the One Health Approach, among other holistic approaches that are based on science, mobilize multiple sectors, disciplines and communities to work together, and aim to sustainably balance and optimize the health of people, animals, plants and ecosystems, recognizing the need for equitable access to tools and technologies including medicines, vaccines and other health products related to biodiversity, while highlighting the urgent need to reduce pressures on biodiversity and decrease environmental degradation to reduce risks to health, and, as appropriate, develop practical access and benefit-sharing arrangements.

Notes:

* For more information, see A/RES/61/295.

** For more information, see A/RES/41/128.

*** For more information, see UN General Assembly Resolution 76/300 of 28 July 2022.

**** For more information, see Rio Declaration on Environment and Development (A/CONF.151/26/Rev.l (vol.l)), United Nations publication, Sales No. E.93.1.8.

***** For more information, see Decision V/6.

Annex D. Opportunities for synergies between Rio conventions

The clear connection between reversal of land degradation and ecosystem restoration creates opportunities for synergies between the CBD and UNCCD monitoring and reporting.

Coordinated efforts to revise NBSAPs and strengthen LDN targets present an immediate opportunity to align restoration commitments to simultaneously realize multiple benefits and maximize returns on investment. Enhancing the synergy between CBD and UNCCD's work may entail:[8]

- Actively bridging institutional, policy development and implementation silos across relevant government institutions responsible for CBD and UNCCD work;

- Undertaking an objective, critical and constructive policy coherence assessment of land restoration targets;

- Jointly mapping strategic intervention areas and corresponding response measures that can be implemented in an effective, complementary, inclusive and mutually supportive manner as part of an integrated landscape approach;

- Prioritizing degraded areas in ecosystems of high integrity and in Key Biodiversity Areas (KBA) when planning land restoration targets, including in freshwater and coastal ecosystems;

- Enhancing the connectivity and integrity of natural ecosystems when planning for land restoration and rehabilitation measures, for example, by adopting biodiversity-friendly practices;

- Including biodiversity-friendly practices when planning land rehabilitation measures across productive landscapes;

- Incorporating human rights considerations and approaches when planning habitat protection and restoration actions aiming at biodiversity conservation;

- Applying the international ecological restoration principles and standards developed by the Society for Ecological Restoration (SER), and the Voluntary Guidelines on the Responsible Governance of Tenure for effective land restoration planning and implementation;

- Co-investing in transformative projects that aim at joint implementation of KM-GBF Target 2 and LDN targets at the national level, and incentivizing research and development of pilot sites where LDN and biodiversity targets can be conceptualized and implemented jointly so further knowledge on the challenges, synergies and opportunities on aligning land-based restoration commitments can be demonstrated.

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[8] More information can be found in UNCCD. 2023. Land restoration to safeguard nature and livelihoods: UNCCD and CBD working together. Bonn (available at: https://www.unccd.int/resources/publications/land-restoration-safeguard-nature-and-livelihoods-unccd-and-cbd-working) and Global Mechanism of the UNCCD. 2024. UNCCD Supplementary Guidelines for Strengthening Land Restoration Commitments and Targets. Bonn. Unpublished.

Annex E. Additional resources, guidelines, and tools

Resources, guidelines, and tools are incorporated into the major groups of activities (A-D) of the STAPER. These groups are: (A) Assessment of Opportunities for Ecosystem Restoration, (B) Improving the Institutional Enabling Environment for Ecosystem Restoration, (C) Planning, Implementation, and Ongoing Management of Ecosystem Restoration Activities, and (D) Monitoring, Evaluation, Feedback and Sharing Results. This resource list is intended to be adaptable and to help countries around the world develop and implement effective ecosystem restoration initiatives. Colour-coding is used to indicate major ecosystem type or types: dark green for terrestrial ecosystems, red for production ecosystems, blue for inland water ecosystems, dark blue for marine ecosystems, and light green for multiple ecosystems.

In addition to the specific resources and tools categorized by major groups of STAPER activities, the following major global resources provide comprehensive guidelines and frameworks applicable across various aspects of ecosystem restoration.

Global resource	Purpose	Year	Lead organization / author	STAPER activities covered			
				A	B	C	D
Action plan for the UN Decade on ecosystem restoration, 2021–2030	A detailed action plan to guide worldwide ecosystem restoration efforts throughout the course of the UN Restoration Decade	2023	UNEP, FAO	✓	✓	✓	✓
Ecological connectivity	The guidelines provide strategies and tools for enhancing ecological connectivity and transboundary conservation to support the KM-GBF and NBSAPs	2023	IUCN World Commission on Protected Areas	✓	✓	✓	
Ecological restoration for protected areas	This resource provides guidance for terrestrial, marine, and freshwater protected area managers on the restoration of natural and associated values in protected areas	2012	IUCN (Keenleyside *et al.*)	✓	✓	✓	✓

Global resource	Purpose	Year	Lead organization / author	STAPER activities covered			
				A	B	C	D
Framework for Ecosystem Restoration Monitoring (FERM)	An operational monitoring and reporting framework developed by FAO and partners for UN Decade on Ecosystem Restoration, included its guideline		FAO	✓	✓	✓	✓
International principles and standards for the ecological restoration and recovery of mine sites	This resource presents the first international framework for the delivery of socially and environmentally responsible ecological restoration after mining, regardless of whether restoration is legally mandated	2022	SER (Young *et al.*)	✓	✓	✓	✓
International principles and standards for the practice of Ecological Restoration	The global standard for ecological restoration practice, including assessment and planning, implementation, monitoring, and ongoing management activities	2019	SER (Gann *et al.*)	✓	✓	✓	✓
International principles and standards for native seeds in ecological restoration	The Standard defines what is considered native seed in ecological restoration and highlights the differences between native seeds versus seeds of improved genetics	2020	SER (Pedrini and Dixon)	✓		✓	
Principles for ecosystem restoration to guide the United Nations Decade 2021–2030	This resource outlines ten principles for ecosystem restoration to guide the UN Decade on Ecosystem Restoration	2021	FAO, IUCN Commission on Ecosystem Management, SER	✓	✓	✓	✓
Restoration opportunities assessment methodology (ROAM)	A strategy framework established to analyse restoration potential across landscapes and inform decision-making processes	2014	IUCN & World Resources Institute	✓	✓		✓

Global resource	Purpose	Year	Lead organization / author	STAPER activities covered			
				A	B	C	D
Road to restoration	A roadmap that provides approaches and strategies for countries to restore landscapes while achieving sustainable development goals. See also AURORA in monitoring below	2019	FAO & World Resources Institute	✓	✓		✓
Scientific conceptual framework for land degradation neutrality	This resource provides a scientific basis for understanding, implementing, and monitoring Land Degradation Neutrality (LDN), bridging the gap between vision and practical implementation	2017	UNCCD (Orr *et al.*)	✓		✓	✓
Standards of practice to guide ecosystem restoration	Key recommendations for ecosystem restoration process, applicable across all sectors of society, land or sea ecosystems, and regions, as well as the broad array of ecosystem restoration activities under the UN Decade on Ecosystem Restoration	2024	FAO, SER, IUCN (Nelson *et al.*)	✓	✓	✓	✓

A. Assessment of opportunities for ecosystem restoration

Resources, guidelines, and tools	Purpose	Year	Lead organization / author	
1 Assessments of Ecosystem Condition and Restoration Commitments				
Assessment report on land degradation and restoration	Report on global land degradation, its effect, prevention, reduction and reversal that provides policymakers to inform and guide decision-making processes at various levels of governance	2018	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services	🟩

Resources, guidelines, and tools	Purpose	Year	Lead organization / author
Forest declaration assessment	Evaluates the Forest Declaration's impact on forest conservation and restoration	2022	Forest Declaration Assessment Partners
Global assessment report on biodiversity and ecosystem services	This resource assesses the status, trends, and impacts of biodiversity and ecosystem services on human well-being and the efficacy of responses	2019	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
Global forest resource assessment (FRA)	This resource is a structured international reporting framework that collects and compiles national forest data via a network of officially designated National Correspondents to assess global forest resources	-	FAO
Global Land Outlook	The document emphasizes land restoration for resilience and sustainable land and water management to improve living conditions and achieve multiple SDGs	2022	UNCCD
Global mangrove watch	This page provides detailed information on the global extent, changes, and species distribution of mangrove habitats, including data on habitat loss, disturbance alerts, and species' conservation status	-	Global Mangrove Alliance
Global peatlands assessment	A comprehensive assessment of the world's peatlands, highlighting their role in climate mitigation and offering guidance for their protection and sustainable management	2022	UNEP
Good practice guidance. SDG indicator 15.3.1, Proportion of land that Is degraded over total land area. Version 2.0.	Provides guidance on calculating land degradation for UN Sustainable Development Goal Indicator 15.3.1, focusing on land cover, productivity, and carbon stocks	2021	UNCCD (Sims *et al.*)
Global wetland outlook	Provides an overview of the status, trends, and importance of wetlands, emphasising the need for their conservation and wise use	2021	Ramsar Convention on Wetlands

Resources, guidelines, and tools	Purpose	Year	Lead organization / author
Restoration Barometer	A tool developed to help pledgers identify, assess, and track action on their restoration commitments of Bonn Challenge	-	IUCN
The second world ocean assessment (WOA II)	The Second World Ocean Assessment (WOA II) provides a comprehensive, integrated scientific evaluation of the global marine environment, addressing environmental, economic, and social aspects to support sustainable development goals	2021	United Nations
The state of the world's mangroves	This resource highlights significant progress in mangrove conservation, restoration, and protection, emphasising the importance of these ecosystems and the urgent need for continued global efforts to safeguard them	2024	Global Mangrove Alliance (Leal *et al.*)
Using ecosystem risk assessment science for ecosystem restoration	This resource is a guide on using ecosystem risk assessment science, specifically the IUCN Red List of Ecosystems, to support ecosystem restoration efforts	2021	IUCN (Valderrábano *et al.*)
2 Prioritisation, Trade-offs and Synergies			
Global priority areas for ecosystem restoration	A study on global priority areas for ecosystem restoration, highlighting the potential benefits for biodiversity conservation and climate change mitigation	2020	Strassburg *et al.*
Identification of ecological restoration priority areas integrating human activity intensity and Multi-Criteria Decision Analysis	The study identifies priority areas for ecological restoration by combining human activity intensity assessment and multi-criteria decision analysis	2023	Wang *et al.*
Landscapes, at your service: applications of the restoration opportunities optimization tool (ROOT)	A resource with a tool for optimization, tradeoff analysis, restoration or management change impact analysis, and spatial prioritisation	2018	IUCN (Beatty *et al.*)

Resources, guidelines, and tools	Purpose	Year	Lead organization / author	
National voluntary land degradation neutrality targets	These targets encourage countries to balance land degradation with restoration efforts by 2030	-	UNCCD	🟩
Prioritizing areas for ecological restoration: A participatory approach based on cost-effectiveness	A participatory cost-effectiveness analysis model for prioritising ecological restoration areas	2023	Silva *et al.*	🟩
se.plan (SEPAL)	A spatially-explicit tool for forest restoration planning decision support that considers restoration cost and benefits to create maps and scenarios of restoration feasibility	2020	FAO	🟩
The biodiversity and ecosystem service contributions and trade-offs of forest restoration approaches	The resource discusses the benefits and trade-offs of forest restoration approaches, highlighting that native forest restoration provides better biodiversity and ecosystem services compared to extensive plantations	2022	Hua *et al.*	🟩
WePlan-Forests	Decision support platform for tropical and subtropical forest ecosystem restoration planning that aims to maximize climate change mitigation and biodiversity conservation benefits, while reducing restoration costs	2019	Institute for Capacity Exchange in Environmental Decisions	🟩
3 Declarations, Calls to Action, Initiatives				
Bonn Challenge and New York Declaration	A global goal to bring 150 million hectares of degraded and deforested landscapes into restoration by 2020 and 350 million hectares by 2030	-	IUCN	🟩
Freshwater Challenge	Country-led initiative for the urgent restoration and conservation of 350 Mha of degraded freshwater ecosystems by 2030, which are critical for biodiversity and human well-being	2023	Colombia, DR Congo, Ecuador, Gabon, Mexico, Zambia	🟦
Glasgow Leaders' Declaration on forests and land use	Forests received unprecedented attention at UNFCCC COP26 in Glasgow when more than 140 countries pledged to halt and reverse deforestation by 2030	2021	UNFCCC	🟩

Resources, guidelines, and tools	Purpose	Year	Lead organization / author
Global Swimways for the conservation of migratory freshwater fishes	It proposes a “Global Swimways” programme to identify and protect rivers that support the migration routes of biologically and socio-economically important freshwater fishes and to identify regions with high species richness, threatened species, or endemic species	2022	Worthington *et al.*
G20 Global Land Initiative	This resource describes the G20’s global initiative on reducing land degradation and enhancing terrestrial habitat conservation	-	UNCCD
Kelp Forest Challenge	A global movement to raise our connection to the ocean and ultimately protect and restore 4 million hectares of kelp forests by 2040	2023	Kelp Forest Alliance
Land, Life and Legacy Declaration	A declaration for urgent, collaborative efforts to manage land sustainably, restore degraded ecosystems, and combat desertification, while promoting gender equality and youth involvement	2022	UNCCD
UN Ocean Decade	Transformative ocean research-based solutions for sustainable development, linking people and our ocean through Ocean Decade Challenges	2021	UNESCO's Intergovernmental Oceanographic Commission
The Coral Reef Breakthrough	The Coral Reef Breakthrough aims to protect 125 000 km² of coral reefs by 2030 with a USD 12 billion investment to support global resilience against climate change	2023	ICRI
The Mangrove Breakthrough	A global call for accelerated action and investment to protect and restore mangroves, aiming to secure over 15 million hectares by 2030	2018	Global Mangrove Alliance

Resources, guidelines, and tools	Purpose	Year	Lead organization / author	
4 Biodiversity, Restoration and Sustainability				
Biodiversity and the 2030 agenda for sustainable development: technical note	This document highlights the critical role of biodiversity in achieving the 2030 Agenda for Sustainable Development	2016	CBD	🟩
Ecosystem restoration for people, nature and climate	A publication by UNEP and FAO describing how ecosystem restoration benefits people, nature, and climate all at once	2021	UNEP, FAO	🟩
Restoring forest and landscape: The key to a sustainable future	A publication of the Global Partnership on Forest and Landscape Restoration that emphasizes the necessity of restoring forests and landscapes for a more sustainable future	2018	International Union of Forest Research Organizations, Global Partnership on Forest and Landscape Restoration (Besseau *et al.*,)	🟩
Restoring the Earth — The next decade	This resource discusses forest and landscape restoration (FLR) opportunities and recent developments aimed at achieving international environmental commitments	2020	FAO	🟩
Supporting the global biodiversity agenda	The document promotes global biodiversity through policies, alliances, and sustainable practices to meet the post-2020 global biodiversity framework and the 2030 Agenda for Sustainable Development	2020	United Nations	🟩
Wetlands restoration: unlocking the untapped potential of the Earth's most valuable ecosystem	The document addresses the importance of wetlands, their significant ecological and socio-economic benefits, and the urgent need for their restoration to support biodiversity, climate resilience, and sustainable development	-	Ramsar Convention on Wetlands	🟦
5 Nature-based Solutions and Climate Change				
Blue carbon: The potential of coastal and oceanic climate action	Business consulting brief on the role of blue carbon in coastal and oceanic climate action	2022	McKinsey & Company (Claes *et al.*)	🟦
Combined biodiversity and carbon management	A technical briefing note on combining biodiversity protection and carbon management to improve ecosystem restoration	2020	UNEP-World Conservation Monitoring Centre	🟩

Resources, guidelines, and tools	Purpose	Year	Lead organization / author
Ecosystem restoration as a Nature-based Solution	A policy brief that emphasizes the role of ecosystem restoration in tackling climate change and biodiversity loss using nature-based solutions	2022	IUCN
Enhancing forest targets and measures in Nationally Determined Contributions (NDCs)	A guide to best practices for improving forest targets and measures in Nationally Determined Contributions (NDCs)	2020	World Wildlife Fund
IUCN Global Standard for Nature-based Solutions: first edition	A user-friendly framework for the verification, design, and scaling up of NbS	2020	IUCN
NDC opportunities in the forest and land-use sector	This resource highlights the possibilities for improving forest-based restoration programmes in Nationally Determined Contributions (NDCs)	2019	World Resources Institute & UNDP

B. Improving the institutional enabling environment for ecosystem restoration

Resources, guidelines, and tools	Purpose	Year	Lead organization / author
1 High-level Analyses			
Delivering an enabling environment and multiple benefits for land degradation neutrality: Stakeholder perceptions and progress	This resource outlines the key components and challenges of creating an enabling environment for achieving land degradation neutrality (LDN)	2020	Allen *et al.*

Resources, guidelines, and tools	Purpose	Year	Lead organization / author
Four steps for the Earth: mainstreaming the post-2020 global biodiversity framework	This document addresses a framework for mainstream biodiversity conservation by integrating specific impact mitigation measures with larger conservation and restoration actions	2021	Milner-Gulland *et al.*
The political ecology playbook for ecosystem restoration: Principles for effective, equitable, and transformative landscapes	This resource presents ten principles to achieve effective, equitable, and transformative landscape restoration by addressing underlying political, economic, and social issues	2021	Osborne *et al.*
To restore coastal marine areas, we need to work across multiple habitats simultaneously	This resource highlights the importance of cross-habitat facilitation in coastal marine restoration, advocating for a shift from single-habitat to multi-habitat restoration practices to enhance ecosystem resilience	2023	Vozzo *et al.*
2 Finance			
Accountability for nature: comparison of nature-related assessment and disclosure frameworks and standards	The document addresses private sector nature-related assessment and disclosure trends for implementing the assessment in their enterprises	2024	UNEP
Cost-effective ecosystem restoration	The resource focuses on providing best practices and cost-effective methods for ecosystem restoration	2023	Department for Environment, Food & Rural Affairs, United Kingdom
Economics of land degradation (ELD) initiative	A global resource providing scientific and practical approaches to valuing land and ecosystems, aiming to promote sustainable land management	2011	UNCCD, German Federal Ministry for Economic Cooperation and Development, European Commission
Scaling up ecosystem restoration finance: A stocktake report	This report highlights challenges, opportunities, and a draft roadmap for scaling restoration investment	2022	The World Bank

Resources, guidelines, and tools	Purpose	Year	Lead organization / author
Finance Task Force of UN Decade on Ecosystem Restoration	One of six standing task forces of the UN Restoration Decade, which has published guidance such as Scaling up ecosystem restoration finance: A stocktake report and Blueprints for private investment in ecosystem restoration: Lessons from case studies	2022	The World Bank
Financial and institutional support are important for large-scale kelp forest restoration	The document emphasizes the critical role of financial and institutional support in achieving large-scale kelp forest restoration, highlighting successful case studies	2020	Eger *et al.*
Natural capital approaches: shifting the UN Decade on Ecosystem Restoration from aspiration to reality	A resource suggesting the use of natural capital approaches to turn the UN Decade on Ecosystem Restoration's goals into implementation	2022	Farrel *et al.*
Roots of prosperity: The economics and finance of restoring land	This resource shows how smart policies and financing can help governments meet restoration goals by highlighting the economic value of ecosystems and addressing financial barriers	2017	World Resources Institute
Species Threat Abatement and Restoration (STAR) metric	A tool for measuring the contribution of investments to reducing species extinction risk	2021	IUCN Species Survival Commission Post-2020 Taskforce
System of Environmental-Economic Accounting — Ecosystem Accounting	The document provides a framework for integrating environmental and economic data to assess and manage ecosystems sustainably	2021	UN System of Environmental-Economic Accounting
TerraMatch	The resource supports locally led land restoration projects by providing funding, technical assistance, and monitoring through TerraMatch's platform	-	World Resources Institute

Resources, guidelines, and tools	Purpose	Year	Lead organization / author	
The Future of nature and business	This resource discusses the relationship between nature conservation, ecosystem restoration, and business	2020	World Economic Forum	🟩
The Restoration Explorer	The Restoration Explorer is a free, online platform that helps users build a resilient restoration enterprise by providing customized business models and resources for ecosystem restoration	-	UNEP	🟩
3 Capacity Building and Knowledge Hubs				
Africa Tree Finder	This easy-to-use app provides data on the distribution of indigenous tree species and natural vegetation types as well as products trees provide, enabling one to select the best tree species for landscape restoration or agroforestry projects	2018	CIFOR-ICRAF	🟧
Capacity, knowledge and learning action plan	A strategic plan to increase capacity, knowledge, and learning for best practices in ecosystem restoration during the UN Decade on Ecosystem Restoration	2022	Taskforce on Best Practices for the UN Restoration Decade	🟩
Ecological Restoration Alliance (ERA) of Botanic Gardens	An alliance of botanic gardens and botanical expertise around the world dedicated to the practice of ecological restoration	2012	Botanic Gardens Conservation International	🟩
Enabling farmer-led ecosystem restoration: Farmer field schools on forestry and agroforestry	This document explains how Farmer Field Schools can help smallholder farmers lead ecosystem restoration and climate change mitigation efforts	2023	FAO	🟧
Environmental Leadership & Training Initiative (ELTI)	A training initiative to empower people from all sectors to restore and conserve tropical forest landscapes through training and support	2006 (est.)	Yale School of The Environment	🟩
Forest Ecosystem Restoration Initiative (FERI)	An initiative to support developing country Parties in operationalizing national targets and plans for ecosystem conservation and restoration	2014	Republic of Korea	🟩

Resources, guidelines, and tools	Purpose	Year	Lead organization / author
Forest Landscape Restoration Mechanism (FLRM) Knowledge Base	This platform provides access to an online user-friendly platform where users can find guidance from planning and implementation to ongoing management and monitoring of a restoration project	-	FAO
Global Biodiversity Information Facility	An international network and a data infrastructure providing open access to biodiversity data to support research and engagement on biodiversity loss and climate change	-	Global Biodiversity Information Facility Secretariat
Global Canopy Height	This resource provides spatially explicit estimates of the predicted uncertainty of retrieved canopy heights	2023	Meta, World Resources Institute
Global Restoration Initiative	A group of experts working to accelerate a locally led, globally important movement to restore land in three key ways: monitoring restoration, financing restoration implementation, and connecting people restoring land	-	World Resources Institute
Global Tree Knowledge Platform	This platform supports the better use of tree species by promoting the right tree in the right place for the right purpose, bringing greater benefits to humans and ecosystems	2021	CIFOR-ICRAF
GlobalUsefulNativeTrees (GlobUNT)	A database that includes 14,014 tree species across 242 countries and territories, developed to support the principles advocated by the 'golden rules for reforestation'	2024	CIFOR-ICRAF, Botanic Gardens Conservation International (Kindt *et al.*)
Learning for Nature	An e-learning programme provided by UNDP that links biodiversity experts and policymakers to foster conservation and achieve Sustainable Development Goals, including NBSAP Forum	2018	UNDP
Restoration Academy	An initiative to link local and national implementers with the UN Restoration Decade of Ecosystem Restoration to share experiences, network, and promote global restoration	2022	UN Restoration Decade

Resources, guidelines, and tools	Purpose	Year	Lead organization / author	
Standards of Practice e-learning	An e-learning course with a scenario-based approach to maximize applied learning and train users on the concepts and use of the UN Decade SOPs to guide ecosystem restoration	2025	FAO	🟩
Target 2 Resource Guide e-learning	An e-learning course that provides an interactive experience to explore the contents of the Resource Guide	2024	FAO	🟩
UN Biodiversity Lab	Provides decision makers with the best available spatial data to put nature at the centre of sustainable development	2022	UNDP, CBD, UNEP	🟩
WOCAT global database on land management	A free access platform, recognized by UNCCD, that documents Sustainable Land Management (SLM) practices worldwide, aiding decision-making and scaling up efforts to prevent and reduce land degradation	2023	UNCCD	🟧
4 Policy				
National policy guiding principles for Forest Landscape Restoration	A set of guiding principles to help define national forest landscape restoration policies	2022	United Nations Economic Commission for Europe	🟩
Policies that support forest landscape restoration	A paper summarising the IUCN's 2020 recommendations for supporting forest landscape restoration	2020	IUCN (Slobodian *et al.*)	🟩
Scaling up wetland conservation and restoration to deliver the Kunming-Montreal Global Biodiversity Framework: Guidance on including wetlands in NBSAPs	The document outlines the critical role of wetlands in achieving the goals of the Kunming-Montreal Global Biodiversity Framework (KM-GBF)	2024	Ramsar Convention on Wetlands	🟦
Science-based ecosystem restoration for the 2020s and beyond	This resource supports the use of science-based principles for ecosystem restoration, addressing problems and opportunities in the 2020s and beyond	2021	Science Task Force for the UN Decade on Ecosystem Restoration	🟩

Resources, guidelines, and tools	Purpose	Year	Lead organization / author	
Supporting the global biodiversity agenda	The document promotes global biodiversity through policies, alliances, and sustainable practices to meet the post-2020 global biodiversity framework and the 2030 Agenda for Sustainable Development	2020	United Nations	🟩
The Landscape Policy Accelerator	A programme that aims to accelerate the implementation of policies that aid in landscape restoration and conservation activities	2020	World Resources Institute	🟩
UNCCD-CBD synergy brief	This brief focuses on exploring actionable pathways to improve cooperation for implementing the Rio conventions and other multilateral agreements to enhance land restoration and support sustainable development	2023	UNCCD, CBD	🟩

C. Planning, implementation, and ongoing management of ecosystem restoration activities

Resources, guidelines, and tools	Purpose	Year	Lead organization / author	
1 Principles, Standards and Guidelines (see also Global Resources above)				
Best practice for the use of scenarios for restoration planning	A reference that outlines best practices for using scenarios in restoration planning	2017	Metzger *et al.*	🟩
Best practice guidelines for mangrove restoration	The guideline brings together the latest accumulated local and scientific knowledge about mangrove restoration best-practices into one comprehensive resource	2023	Beeston *et al.*	🟦
Biodiversity guidelines for forest landscape restoration opportunities assessments, First edition	These guidelines provide context, resources, and fresh perspectives to the ongoing global interaction between biodiversity conservation and forest landscape restoration	2018	IUCN (Beatty *et al.*)	🟩

Resources, guidelines, and tools	Purpose	Year	Lead organization / author	
Climate change mitigation in the endangered landscape programme: guidance and tool protocols	This resource provides guidance on how to assess the contribution of an action to climate change, as well as providing a sampling of state, local, and foreign protocols	2021	UNEP (Critchley *et al.*)	🟩
Developing guidelines and a theory of change framework to inform rewilding application	This resource offers guidelines, interventions, and a theory of change framework to help practitioners apply rewilding effectively and achieve consensus in the field	2024	Hawkins *et al.*	🟩
Embedding Indigenous knowledge in the conservation and restoration of landscapes	This resource presents a set of principles and practices that are intended to guide the actions and thought processes of investors in order to engage Indigenous peoples and their knowledge in the conservation and restoration of landscapes	2023	World Economic Forum	🟩
European guidelines on biosecurity in native oyster restoration	Provides guidance on biosecurity considerations when planning and undertaking oyster reef restoration in Europe	2020	Native Oyster Network (zu Ermgassen *et al.*)	🟦
Forest Landscape Restoration: Integrated approaches to support effective implementation	This resource integrates the diverse dimensions of implementing forest landscape restoration (FLR), focusing on an interdisciplinary approach	2018	Mansourian & Parrotta (Eds.)	🟩
Global guidelines for peatland rewetting and restoration	This guideline provides comprehensive technical guidance and background information on peatland rewetting and restoration for regional planners, site managers and policymakers	2021	Ramsar Convention on Wetlands	🟦
Global guidelines for the restoration of degraded forests and landscapes in drylands	This guide provides the tools and scientific basis for global guidelines on dryland restoration	2015	FAO	🟩
Guidelines for forest landscape restoration in the tropics - Policy Brief	These guidelines are linked to the six globally recognized FLR principles and provide guiding elements and recommended actions for each (and also include case studies)	2020	International Tropical Timber Organization	🟩

Resources, guidelines, and tools	Purpose	Year	Lead organization / author	
Guidelines for reintroductions and other conservation translocations	This resource emphasizes the need for rigorous planning, risk assessment, and monitoring to ensure conservation benefits and minimize ecological and social risks when reintroducing and translocating plants and animals	2013	IUCN Species Survival Commission	🟩
Human dimensions of Forest Landscape Restoration	The resource provides guidance to practitioners so that they can better integrate human dimensions into their work in FLR and broader ecosystem restoration	2024	International Union of Forest Research Organizations (Mansourian *et al.*)	🟩
Implementing forest landscape restoration, a practitioner's guide	This guide provides a training resource for Forest Landscape Restoration facilitators on a broad approach to land management	2017	International Union of Forest Research Organizations (Stanturf)	🟩
Marine connectivity conservation 'Rules of Thumb' for MPA and MPA network design	A guideline for designing Marine Protected Areas (MPAs) and MPA networks to enhance marine connectivity and conservation	2021	IUCN World Commission on Protected Areas (Lausche *et al.*)	🟦
Operational guidance on environmental restoration and compensation	This document advises businesses on how to handle environmental restoration and compensation in relation to their no-deforestation and no-conversion commitments	2019	Accountability Framework initiative	🟩
Open Standards for the practice of conservation	A framework that unifies standard principles and practices for conservation project design, implementation, and management	2004	Conservation Measures Partnership	🟩
Principles and guidelines for wetland restoration	These guidelines provide the foundation of a successful wetland restoration project as well as a step-by-step process guiding the identification, development, and implementation of a restoration project	2002	Ramsar Convention on Wetlands	🟦
Restoration guidelines for shellfish reefs	This guide provides both guidance in decision-making for establishing shellfish reef restoration projects and examples of different approaches	2019	The Nature Conservancy, SER (Fitzsimons *et al.*)	🟦
Restoring life to land: the role of sustainable land management in ecosystem restoration	This resource demonstrates the way sustainable land management (SLM) supports ecosystem restoration and provides various benefits, with examples of effective practices	2021	UNCCD, World Overview of Conservation Approaches and Technologies (WOCAT) (Critchley *et al.*)	🟩

Resources, guidelines, and tools	Purpose	Year	Lead organization / author	
Ten golden rules for reforestation to optimize carbon sequestration, biodiversity recovery and livelihood benefits	The resource addresses the environmental risks of large-scale tree planting and offers 10 golden guidelines, based on recent ecological research, to restore forests to maximize carbon sequestration, biodiversity recovery, and livelihoods	2021	Di Sacco *et al.*	🟩
Voluntary guidelines for forest landscape restoration under AFR100	Guidelines for forest landscape restoration in Africa, highlighting restoration opportunities and the African Union's goal to restore 100 million hectares by 2030	2017	AFR100 – The African Forest Landscape Restoration Initiative	🟩
The 4 Returns Framework for Landscape Restoration	The publication introduces the 4 Returns Framework for landscape restoration, balancing stakeholder demands for natural, social, and economic returns through a community-owned approach	2021	Commonland, World Wildlife Fund, Landscape Finance Lab and Wetlands International (Dudley *et al.*)	🟩
Translating the 10 golden rules of reforestation for coral reef restoration	This resource proposes a framework for effective coral reef restoration, adapting forest restoration principles, and emphasising resilience and local stewardship during the UN Decade on Ecosystem Restoration	2021	Quigley *et al.*	🟦
2 Certification and Verification				
Ecosystem Restoration Standard (PBN)	The Standard provides a structured approach and detailed checklist for verification of field performance in implementing ecosystem restoration	2022	Preferred by Nature	🟩
Ecosystem Restoration Standard (ERS)	The standard is designed to empower efforts that combat climate change, uplift biodiversity, and improve livelihoods	2024	Ecosystem Restoration Standard	🟩
General guide for the implementation of the sustainable agricultural standard	This guide helps Certificate Holders implement the Rainforest Alliance Sustainable Agriculture Standard by clarifying requirements and evidence requests	2021	Rainforest Alliance	🟧
SER Certified Ecological Restoration Practitioner (CERP) Program	The programme sets a high professional standard for those designing, implementing, overseeing, and monitoring ecological restoration projects	2017	SER	🟩

Resources, guidelines, and tools	Purpose	Year	Lead organization / author	
The Global Biodiversity Standard	An international certification for restoration and biodiversity-related initiatives that recognizes and promotes the protection, restoration, and enhancement of biodiversity, with an accompanying manual available for guidance	2024	Botanic Gardens Conservation International, SER, Plan Vivo, TRAFFIC	🟩
UEBT Regenerative Programme	The programme helps supply chains measure the impact of cultivation and wild harvesting, use generative impact indicators to track biodiversity regeneration and ecosystem restoration, and improve sustainable production ecosystems	2023	Union for Ethical BioTrade	🟧
3.1 Practical Tools and Implementation Guides (Multiple Ecosystems)				
Emerging lessons for mainstreaming Ecosystem-based Adaptation: Strategic entry points and processes	This document highlights success stories about mainstreaming Ecosystem-based Adaptation (EbA) into national, sectoral, and local planning and decision-making	2019	Deutsche Gesellschaft für Internationale Zusammenarbeit	🟩
Explore before you restore: Incorporating complex systems thinking in ecosystem restoration	The paper emphasizes the need for a Complex System Thinking assessment phase in restoration project cycles to improve ecosystem restoration outcomes	2024	Maes *et al.*	🟩
Healthy country planning	A resource for participatory, cross-cultural ecosystem planning with Indigenous communities	2017	Conservation Coaches Network	🟩
RAD Adaptive management for transforming ecosystems	Integrating the resist-accept-direct (RAD) framework with adaptive management to help natural resource managers navigate ecosystem transformations and make informed decisions	2022	Lynch *et al.*	🟩
Species recovery manual	This manual provides guidance on key elements to guide species recovery projects, focused on vascular plants	2018	Botanic Gardens Conservation International (Heywood *et al.*)	🟩
Ten people-centered rules for socially sustainable ecosystem restoration	The resource provides actionable approaches to centre humans and social factors in ecosystem restoration for equitable and sustainable initiatives	2022	Elias *et al.*	🟩

Resources, guidelines, and tools	Purpose	Year	Lead organization / author
3.2 Practical Tools and Implementation Guides (Terrestrial Ecosystems)			
Delivering tree genetic resources in forest and landscape restoration	The resource emphasises the critical role of tree genetic resources in achieving global goals for restoring degraded forests and landscapes in drylands. It is complemented by a training guide on forest genetic resources and an e-learning module on planning seed and seedling supply in restoration (2023). Preceded by Bozzano *et al.* (2014) and Thomas *et al.* (2014)	2023	FAO, Bioversity International (Gaisberger *et al.*)
Diversity for Restoration (D4R)	An online tool to identify suitable tree species and seed sources for climate-resilient tropical forest landscape restoration		Alliance of Bioversity International & the International Center for Tropical Agriculture
Guidance for successful tree planting initiatives	This resource outlines the complexity of tree planting initiatives and offers guidelines for success, stressing clear goals, addressing deforestation, ecosystem focus, coordinated land use, and stakeholder involvement	2020	Brancalion & Holl
Planning seed and seedling supply for forest and landscape restoration	This course explores how to plan seed and seedling supply for forest and landscape restoration (FLR)	2023	FAO
Practical applications of soil microbiota to improve ecosystem restoration: current knowledge and future directions	This resource describes how soil microbes improve biodiversity, functioning, and resilience in ecosystem restoration	2024	Peddle *et al.*
Restoring tropical forests: a practical guide	This book provides generic concepts and practices that can be applied to revive tropical forests and includes case studies that illustrate a diversity of successful restoration projects from around the world	2013	Royal Botanic Gardens, Kew (Elliott *et al.*)
Roadside revegetation: An integrated approach to establishing native plants and pollinator habitat	This guide offers an integrated approach to facilitate the successful establishment of native plants and pollinator habitats along roadsides and other areas of disturbance associated with road modification	2019	United States Department of Transportation

Resources, guidelines, and tools	Purpose	Year	Lead organization / author
3.3 Practical Tools and Implementation Guide (Inland Water Ecosystems)			
Critical site network	The page provides tools and resources for searching and analysing data related to countries, sites, and species, with a focus on Ramsar Convention on Wetlands criteria for wetland conservation		BirdLife International, Wetlands International
Peatland restoration guide — planning restoration projects	This guide is mainly for the horticultural peat industry; it may also be useful for broader peatland restoration	2020	Peatland Ecology Research Group, Canadian Sphagnum Peat Moss Association, & Quebec Peat Moss Producers Association (Quinty *et al.*)
Principles of low-tech process-based restoration	The resource covers the underlying principles necessary to understand low-tech process-based restoration of riverscapes	2019	Utah State Unversity Restoration Consortium (Wheaton *et al.*)
Science base and tools for evaluating stream engineering, management, and restoration proposals	This document provides the tools and scientific basis to evaluate common stream management practices	2011	United States National Oceanic and Atmospheric Administration (Skidmore *et al.*)
Stream habitat restoration guidelines	This guidance covers stream restoration methods, case studies, data compilation, assessments, field data collection, analysis tools, and design guidance, serving as a resource for restoration planning	2018	United States Department of Agriculture (Yochum)
Wetland restoration	This involves practices such as re-establishment, rebuilding of a former wetland, rehabilitation, and repairing the functions of a degraded wetland	2017	Association of State Wetland Managers (Stelk *et al.*)
3.4 Practical tools and implementation guide (coastal and marine ecosystems)			
A manager's guide to coral reef restoration planning and design	This guide provides steps, adaptive management planning process to assist managers in setting and meeting their restoration goals	2020	United States National Oceanic and Atmospheric Administration (Shaver *et al.*)
Coral-focused climate change adaptation and restoration based on accelerating natural processes	This resource proposes a new paradigm for coral-focused climate change adaptation and restoration, aiming to help coral reefs adapt to rising temperatures	2023	Bowden-Kerby

Resources, guidelines, and tools	Purpose	Year	Lead organization / author
Coral reef restoration: As a strategy to improve ecosystem services	A guide to present an overview of the best-available knowledge in coral reef restoration, providing recommendations for the use of restoration as a management strategy for coral reefs	2020	UNEP (Hein *et al.*)
European native oyster habitat restoration handbook	Provides guidance and examples of oyster reef restoration in the context of Europe	2020	Native Oyster Network (Preston *et al.*)
Mars Assisted Reef Restoration System	This website provides an overview of the project, detailing the Mars Assisted Reef Restoration System (MARRS) and its success in rebuilding damaged coral reefs in Indonesia and other tropical oceans through community and scientific collaboration	-	Mars, Incorporated
Restoration, creation and management of salt marshes and tidal flats	Provides guidelines for restoring, creating, and managing salt marshes and tidal flats	2024	Wetlands International, Conservation Evidence Group
Reef rehabilitation manual	This manual provides detailed hands-on advice, based on lessons learned, on how to carry out coral reef rehabilitation in a responsible and cost-effective manner	2010	Coral Reef Initiatives for the Pacific (Edwards (e.d.))
Reef restoration training hub	This page provides comprehensive resources and training opportunities for reef restoration, including manuals, online courses, and guidelines to support community and global efforts in coral reef recovery		Reef Ecologic
Setting objectives for oyster habitat restoration using ecosystem services: A manager's guide	Provides guidance on the benefits of oyster reef restoration from the marine resource management perspective	2016	The Nature Conservancy (zu Ermgassen *et al.*)
The Climate-Smart Mangrove Tool	This resource is a guidance manual designed to help practitioners incorporate climate change considerations into the conservation, restoration, and management of mangrove ecosystems	2024	The University of Queensland, World Wildlife Fund (Purandare *et al.*)

Resources, guidelines, and tools	Purpose	Year	Lead organization / author
3.5 Practical Tools and Implementation Guide (Production Ecosystems)			
A collection of tools for land restoration	A compilation and assessment of restoration tools from CGIAR centres to inform different stakeholders involved in FLR at different scales and help them navigate the huge diversity of existing tools to support design, implementation and assessment of restoration projects	2021	CIFOR-ICRAF
Building a common vision for sustainable food and agriculture	This resource aims to accelerate the transition to sustainable agrifood systems, including restorative activities such as enhancing natural resources and the resilience of people, communities, and ecosystems	2014	FAO
Cacao diversity	This webpage and tool provide location-specific information to improve the sustainability of cacao farms in South America by addressing climate change impacts	-	Alliance Bioversity & CIAT
My Farm Trees	A platform and a smartphone app which incentivizes farmer- and community-led restoration of degraded landscapes. It enables documentation, verification, and quality control of tree-based restoration efforts	-	IUCN
Options by Context (OxC) for land restoration	To improve the selection of locally relevant options for land restoration, this step-by-step guide matches tailored solutions to local conditions for practitioners and trainers, and provides practical examples and case studies	2022	CIFOR-ICRAF
Restoration of biodiversity and ecosystem services on agricultural land	Describes strategies for restoring biodiversity and ecosystem services on agricultural land through land sharing and land separation approaches	2012	Benayas and Bullock.

D. Monitoring and reporting Target 2 at the national level across ecosystems

Resources, guidelines, and tools	Purpose	Year	Lead organization / author	
1 Indicators				
Biodiversity Indicators Partnership (BIP)	A global initiative to promote and coordinate the development and delivery of biodiversity indicators for use by the CBD and other biodiversity-related conventions	2007	UNEP-World Conservation Monitoring Centre	🟩
2 Participatory monitoring				
Participatory monitoring to connect local and global priorities for forest restoration	This resource suggests participatory monitoring can effectively monitor forest restoration at an efficient cost	2018	Evans *et al.*	🟩
Participatory monitoring and forest restoration	The resource explains participatory monitoring by drawing lessons from existing knowledge and suggesting a path forward to improve forest restoration initiatives	2016	CIFOR, IUCN, Consortium of International Agricultural Research Centers	🟩
Regreening Africa App	A mobile based application to allow users to collect information at farm level on a range of land restoration practices and activities enabling robust landscape level monitoring and assessing effectiveness of practices on the ground	2022	CIFOR-ICRAF	🟩
3 Restoration Project Data				
Mangrove Restoration Tracker Tool (MRTT)	A platform to help practitioners record, track, and improve mangrove restoration projects, promoting sustainable and effective conservation efforts globally	-	Global Mangrove Alliance	🟦
Restor	A GIS-based platform to showcase restoration project efforts, and to support the communities protecting and restoring nature	2021	Restor	🟩

Resources, guidelines, and tools	Purpose	Year	Lead organization / author	
Restoration Evidence Portal	A platform that provides information on the effectiveness of different ecosystem restoration activities through the Conservation Evidence website. It is designed to support decisions about how to conserve, maintain, and restore global biodiversity	2018	Cambridge Conservation Initiative	🟩
SER Restoration Resource Center (RRC)	An interactive platform for knowledge sharing and learning in the field of ecological restoration	2017	SER	🟩
4 Tools and frameworks				
A diagnostic for collaborative monitoring in forest landscape restoration	A tool that helps practitioners assess their collaborative monitoring readiness, identify areas for improvement, and evaluate existing monitoring systems	2020	Guariguata & Evans	🟩
Application of quality assurance and quality control principles to ecological restoration project monitoring	This guidance encourages and facilitates the adoption of effective quality assurance (QA) and quality control (QC) strategies in support of ecological restoration projects	2019	United States Environmental Protection Agency	🟩
Assessment, understanding and reporting of restoration activities (AURORA)	A tool based on The Road to Restoration designed to help stakeholders develop a monitoring system for ecosystem restoration actions tailored to their needs by identifying indicators and metrics to monitor progress toward their set goals	2022	FAO, World Resources Institute	🟩
Chasing success: A review of vegetation indicators used in riparian ecosystem restoration monitoring	This resource focuses on the monitoring methodologies and vegetation indicators used to evaluate restoration outcomes	2024	Cupertino *et al.*	🟦
European native oyster habitat restoration monitoring handbook	Details minimum monitoring requirements for oyster reef restoration in Europe and provides details on optional monitoring to facilitate comparison between restoration projects in the region	2021	Native Oyster Network (zu Ermgassen *et al.*)	🟦
Global Restoration Information Hub	A simplified monitoring tool to track loss (and recovery) of biodiversity across the globe	2024	UNCCD	🟩

Resources, guidelines, and tools	Purpose	Year	Lead organization / author	
IUCN restoration intervention typology for terrestrial ecosystems	The document classifies ecosystem restoration activities, including natural and artificial regeneration, species control, and habitat protection across terrestrial ecosystems in support of the Restoration Barometer	2022	IUCN	🟩
LandScale	A comprehensive methodology for monitoring, assessing, and reporting the soil and ecosystem health of a landscape	-	Rainforest Alliance and Conservation International	🟩
Open Foris	Free and open-source tools developed for land-monitoring and include restoration specific applications for field data collection using Ground and monitoring using Collect Earth	-	FAO	🟦
Practical river restoration appraisal guidance for monitoring options (PRAGMO)	A resource to assist all practitioners in the process of setting monitoring objectives as part of a river restoration project	2023	The River Restoration Center	🟦
Protocol for monitoring tropical forest restoration: Perspectives from the Atlantic Forest Restoration Pact in Brazil	A protocol developed through an iterative process involving over hundreds of stakeholders for monitoring Brazilian Atlantic Forest restoration	2017	Viani *et al.*	🟩
Remote sensing techniques for mapping and monitoring mangroves at fine scales	A guideline targeted to build capacity for mangrove resource managers on how to use and take advantage of the latest technologies in mapping and monitoring mangroves	2024	FAO (Schill *et al.*)	🟦
Restoration monitoring tools guide	This website provides support for users set up and select tools for monitoring forest and landscape restoration projects	2023	Climate Focus, World Resources Institute	🟩
Sustainability Index for landscape restoration	A tool for monitoring the biophysical and socioeconomic impacts of landscape restoration	2017	World Resources Institute (Cristales *et al.*)	🟩
The Land Degradation Surveillance Framework (LDSF)	A comprehensive methodology for monitoring, assessing, and reporting the soil and ecosystem health of a landscape	2023	CIFOR-ICRAF	🟩

Resources, guidelines, and tools	Purpose	Year	Lead organization / author
Tree restoration monitoring framework — field test edition	This resource offers comprehensive methods for monitoring restoration success and co-benefits, supporting the Priceless Planet Coalition's goal to restore 100 million trees by 2030	2022	Conservation International
5 Emerging Technologies and Big Data			
Existing and emerging uses of drones in restoration ecology	This resource highlights potential to improve restoration planning, implementation, and monitoring, while addressing technical and practical constraints	2022	Robinson *et al.*
Guidelines for planning genomic assessment and monitoring of locally adaptive variation to inform species conservation	This document provides guidelines for planning genomic assessments and monitoring locally adaptive genetic variation to inform species conservation	2018	Flanagan *et al.*
Harnessing big data to support the conservation and rehabilitation of mangrove forests globally	This article outlines how big data and remote sensing are being used to conserve and rehabilitate mangrove forests globally by providing comprehensive datasets and tools for policymakers and conservationists	2020	Worthington *et al.*
Key factors to consider in the use of environmental DNA metabarcoding to monitor terrestrial ecological restoration	This resource highlights the use of environmental DNA (eDNA) metabarcoding to monitor terrestrial ecological restoration for effective application	2022	Heyde *et al.*
Measuring and monitoring restored ecosystems: can remote sensing be applied to the ecological recovery wheel to inform restoration success?	The article describes how remote sensing can be used with the Ecological Recovery Wheel as a monitoring framework	2022	McKenna *et al.*

Resources, guidelines, and tools	Purpose	Year	Lead organization / author
New technologies for monitoring and upscaling marine ecosystem restoration in deep-sea environments	This resource focuses on the use of advanced robotic platforms and sensors to conduct autonomous restoration and long-term ecological monitoring	2024	Aguzzi *et al.*
6 Data Interoperability			
Global indicators for monitoring ecosystem restoration — A contribution to the UN Decade on Ecosystem Restoration	This document summarizes the global-level indicators identified by the UN Restoration Decade Monitoring Task Force and associated experts during 2020 and 2021 related to restoration progress	2022	FAO, UNEP
Knowledge sharing for shared success in the decade on ecosystem restoration	This resource underlines the significance of information and data sharing in ecological restoration for improving predictive capability and evidence-based decision-making in the restoration of biodiversity and ecosystem services	2021	Ladouceur *et al.*
Land Cover Classification System. Classification concepts Software version 3	This resource provides a standardized, object-oriented approach for classifying and describing land cover to improve global data consistency, interoperability, and accuracy in environmental monitoring and land management	2016	FAO
Restoration project Information Sharing Framework (ISF)	An interoperability framework for tracking progress of ecosystem restoration projects, including headline, core, and secondary indicators, and project descriptors	2022	Climate Focus, SER (Gann *et al.*)

In collaboration with

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World Agroforestry

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FRAMEWORK

ISBN 978-92-5-139246-1

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CD2925EN/1/10.24